Impact of Empty Container Repositioning On Container Inventory Management: A Case Study of Dar Es Salaam Port

Miriamu Nicodemo Benjamini

Department of Science and Management at Dar es Salaam Maritime Institute (DMI)
P.O. Box 6727, Dar es Salaam, Tanzania

Dr. Julieth Koshuma

Lecturer, Department of Science and Management at Dar es Salaam Maritime Institute
P.O.Box 6727, Dar es Salaam, Tanzania

*Abstract-*This study examined the impact of empty container repositioning on container inventory management, a case study of Dar es Salaam port. The study aimed to understand how misaligned repositioning of containers contributes to inefficiencies in inventory management and to delineate strategies aimed at enhancing the overall flow of containers and the performance of the port.

A mixed-methods research framework was employed, integrating qualitative interviews with significant stakeholders within the port and quantitative analyses derived from operational records and container movement logs. Primary data were gathered through structured interviews conducted with logistics managers, shipping agents, and officials from the port authority, while secondary data encompassed repositioning schedules, reports on container inventories, and records on depot capacities. The analysis of data concentrated on discerning patterns of discrepancy between repositioning methodologies and the actual demand for containers within various segments of the port system.

The findings indicate that, despite the frequency of repositioning activities, there exists a significant lack of synchronization with real-time inventory requirements, resulting in persistent shortages of containers in export zones and surpluses within storage areas. These discrepancies culminate in heightened storage costs, delays in exports, and suboptimal utilization of resources. Furthermore, the study identifies critical operational challenges, including sluggish container movement, insufficient depot capacity, antiquated monitoring systems, inadequate coordination among stakeholders, infrastructural deficits, and a scarcity of skilled labor.

In spite of these obstacles, a number of potential solutions have been identified. The implementation of forecasting tools could serve to better align repositioning with demand; container leasing can provide necessary flexibility during peak operational periods; and fostering logistics partnerships along with stakeholder collaboration may enhance the inland flow of containers and the distribution of inventory. Nonetheless, the effectiveness of these measures remains limited due to insufficient institutional support and inadequate integration into existing port operations. The study concludes that enhanced coordination, data-informed decision-making, and investments in both infrastructure and technology are imperative for the effective management of container inventories at the Port of Dar es Salaam

Index Terms: Container, empty container repositioning, port, container inventory management, container storage

INTRODUCTION

Container transportation is a fundamental component of the global economy, facilitating international trade, reducing logistics costs, and enhancing supply chain efficiency. The rapid growth of container traffic has transformed global commerce by providing a standardized, efficient, and secure transport method. This evolution has enabled businesses to expand their reach and integrate into international markets, making container shipping a critical enabler of globalization(Malashchuk & Hrynchak, 2018).

Furthermore, containerization has significantly contributed to economic and industrial development by lowering transportation costs and improving trade efficiency. It has been key in linking production hubs with consumer markets, enabling businesses to optimize their supply chains and remain competitive in a globalized environment(Vinogradov & Vyazovaya, 2022). Advancements in container handling technology, such as intelligent loading systems and digital logistics platforms, have enhanced the efficiency and reliability of container transportation. Despite its many advantages, container shipping confronts issues such as port congestion, trade imbalances, and environmental concerns, which demand constant improvements in infrastructure and sustainability programs(Wang et al., 2016).

 Many international ports and shipping companies use integrated optimization models that combine container pooling, demand forecasting, and dynamic inventory control to reduce this. Predictive analytics and artificial intelligence are also employed to enhance forecasting accuracy and container flow visibility(Sáinz Bernat et al., 2016). Global ECR issues still persist despite technological advancements because of diverse container fleet ownership, rivalry among liner alliances, and a lack of data exchange. Improving operations is only part of the solution; another is fostering cooperation among supply chain participants worldwide.

The handling of empty containers is more difficult on the African continent because of inadequate intermodal connectivity, smaller export quantities, and limited infrastructure. Due to the significant import bias at the majority of African ports, there are a lot of empty, idle containers(Lapshin, 2023). Due in significant part to inadequate inland transportation networks and limited hinterland access, ports like Mombasa, Lagos, and Dar es Salaam struggle to reposition empty containers effectively

Some African countries are making investments in regional cooperation and dry ports, or inland container depots, to address these problems and balance trade flows. However, the impact of these solutions is still restricted in the absence of integrated port community systems, real-time container tracking, and improved public-private cooperation. Furthermore, container circulation and the cross-border application of contemporary ECR techniques are frequently hampered by legislative barriers, corruption, and customs inefficiencies.

Container transportation in Tanzania faces several challenges that impact its efficiency, cost-effectiveness, and reliability. A major issue is the high cost of fuel, which significantly affects transport operations. The ongoing trade imbalance is a key obstacle to Tanzania's efforts to reposition empty containers. There are too many vacant containers at major ports like Dar es Salaam because Tanzania imports far more goods than it exports. Imported commodities often arrive in containers that remain in the country without enough exports to efficiently return and refill them, causing this imbalance. (Lapshin, 2023).

Statement of the problem

In international shipping operations, managing empty containers is a major challenge, especially in regions with large trade imbalances. This issue is especially evident in Dar es Salaam, Tanzania's main port city, where an uneven flow of imports and exports causes an accumulation of empty containers. Due to this imbalance, these containers need to be repositioned, which is costly and complicates inventory management at empty container depots (Abdelshafie et al., 2022).

Repositioning empty containers contributes between 5% and 8% of a shipping line's operating expenses, highlighting the financial strain it places on the sector. The port's monthly processing capacity in Dar es Salaam has grown from 60,000 to 100,000 containers, making effective empty container management even more crucial. The Central Corridor Transit Transport Facilitation Agency (2023) reports that the Tanzania Ports Authority (TPA) has taken steps to reduce port congestion by allowing the transfer of domestic import containers to bonded Inland Container Depots (ICDs) when empty containers build up at ports as a result of low export demand, shipping companies are frequently forced to pay extra to relocate them in areas with greater demand(Flory & Secretary, n.d.). The imbalance between import and export activity, which results in an excess of empty containers and higher operating expenses, is one problem that still exists despite these efforts. This circumstance emphasizes the necessity for more efficient methods to control the stock of empty containers in Dar es Salaam port.

Research objectives

The Study's general objective was the impact of empty container repositioning on the container inventory management.

 Specific Objectives

   i.   To determine the impact of empty container repositioning on the container inventory level in Tanzania
   ii.   To examine the operational challenges of container repositioning on empty container storage
   iii. To identify the strategies for optimizing empty container repositioning to improve container inventory management

RESEARCH METHODOLOGY

The study investigated the impact of empty container repositioning on container inventory management, a case of Dar es Salaam port, employing a case study approach integrating both qualitative and quantitative approaches. The qualitative approach involved interviews and surveys with stakeholders involved in issues of container transportation, such as ICD officials, importers and exporters, shipping lines, clearing and forwarding agents, to gain insights and experiences of stakeholders. The quantitative approach used logistical data, such as costs, inventory levels, and repositioning frequency, as one of the variables in empty container repositioning. This study design was used because a mixed-methods strategy works best for recording both subjective viewpoints and statistical patterns.

This research employed both probability sampling and non-probability sampling. In probability sampling, a purposive sampling technique was used to analyze the topic under study. This technique was chosen because the study involves knowledgeable people in the study of empty container repositioning and container inventory management. The advantage of purposeful sampling is that it allows for the selection of data for in-depth analysis of the main topics under consideration. In non-probability sampling, a simple random sampling technique was used. Simple random sampling is a sampling in which the researcher randomly selects a subset of participants from a population. Each member of the population has an equal chance of being selected, so this technique was used because it allows all participants in empty container repositioning and container inventory management to have an equal chance of being selected. Ultimately, the sample size of 60 respondents was determined by using Yamane's formula.

Data collection involved multiple methods of gathering both primary and secondary information. Primary data collection involves gathering original data directly from sources for a specific research purpose(Karunarathna et al., 2024). In this study, the primary data collection was conducted by using structured questionnaires and interviews. Documentary review was the secondary data collection method used in this study by analyzing the existing data about the study. This comprehensive data collection strategy enabled the researcher to triangulate the findings to ensure the robustness of the study.

Data processing and analysis were conducted using the Statistical Package for the Social Sciences (SPSS). The qualitative data from interviews were analyzed using three thematic analysis techniques. This involved data reduction, data display, and drawing conclusions based on the qualitative data collected through interviews and questionnaires. Data reduction included selecting, simplifying, and transforming the acquired data to coherently connect it to the research topic. For the quantitative approach, descriptive analysis, including medians, frequencies, and proportions, was employed to uncover the basic patterns and distributions within the data.

RESULT AND DISCUSSION

Demographic information

Table 1.1 Respondents' work experience

Years of experience	Frequency	Percentage (%)
Less than 5 years	10	20
5-10 years	25	50
More than 10 years	15	30

Source: Field,2025

The study evaluated the respondents' job experience in the shipping sector, particularly regarding container inventory management at or near Dar es Salaam Port. The majority of participants, or a sizable share of all responses, had 5-10 years of professional experience, according to the findings. The study revealed that 50% of respondents were mid-level professionals who had a thorough awareness of the administrative and operational facets of handling and relocating containers.

Their degree of experience indicates that they have encountered the real-world difficulties related to port congestion, container imbalances, and the logistics of repositioning plans. As a result, the responses are regarded as trustworthy and perceptive, offering a solid basis for examining how empty container relocation affects container inventory control

The Impact of Empty Container Repositioning on Container Inventory Level in Tanzania

Table 1.2 Response on the Impact of Empty Container Repositioning on Container Inventory Level in Tanzania

Variable	Category	Frequency Percentage (%)	Percentage (%)
Frequency of Repositioning	Often or very often	40	80
Monthly value Repositioned	1000-2499 TEUS	30	64
Empty Container Inventory	41%-80%	32	66
Inventory Impact	Increased inventory	35	80
Average Lead Time	7.5 days	-	
Shortage Due to Delay	Yes	32	64

Source: Field

The findings in Table 1.2 have revealed that 80% of participants have said that they frequently repositioned empty containers. This suggests that the port of Dar es Salaam regularly and routinely repositions empty containers. The implication of often or frequently repositioning the empty container on the container inventory level is that if the frequency of repositioning can lead to empty container build-up, it and operational if it is not accompanied by precise demand forecasting. Frequent repositioning can result in port congestion, inefficient equipment utilization, and yard overcrowding if it is not effectively handled.

Also**,** this study's findings have revealed that the volume of container movement, as suggested by the majority of respondents, reported that monthly repositioning volumes range from 1,000 to 2,499 TEUs. This significant volume at Dar es Salaam Port illustrates the port's strategic importance in the East African commerce corridor and its function as a hub for regional trade in landlocked countries. The volume of 2499 TEUs signifies that the Port and depot storage space and handling capacity are put under further strain when managing high volumes of shifted empties. Such quantities increase inventory pressure, particularly in ports like Dar es Salaam, where depot automation and terminal development are still scarce. This emphasizes the necessity of off-dock storage facilities and space optimization techniques to effectively handle repositioning empties.

Furthermore, the results derived from the research suggest that a considerable fraction of the container inventory at Dar es Salaam Port, ranging from 41% to 80% is comprised of empty containers. This substantial ratio underscores a profound disparity in container circulation, wherein a greater number of containers are being returned empty rather than being utilized for export purposes. This configuration implies that a considerable amount of yard space and resources are allocated to the storage of assets that do not generate revenue. Unoccupied containers, while integral to the logistics cycle, fail to produce income unless they are adeptly repositioned or loaded with cargo. Consequently, their uneven presence within the inventory signifies inefficiencies in the management, rotation, and redistribution of containers.

Moreover, the study findings have revealed that 70% of participants in the study indicated that the improper activities related to repositioning result in the accumulation of empty containers in the port and increase inventory levels at the port. This suggests that containers, once subjected to repositioning, frequently remain inactive for extended durations rather than being promptly redeployed or utilized for outbound consignments

Similarly, the Respondents reported an average lead time as of the impact on container inventory level of 7.5 days for repositioning. The amount of time that passes between returning an empty container and making it accessible for reuse or redeployment is reflected in this delay. Logistical obstacles, including sluggish customs paperwork, ineffective stacking systems, and disorganized repositioning orders, might prolong this and may lag the lead time at Dar es Salaam

Repositioning empty containers at Dar es Salaam Port takes an average of 7.5 days, which has a big impact on supply chain dependability and port efficiency. Long lead times signify a delay in releasing empty containers for export or reuse, which can cause shipping schedule disruptions and impair the port's ability to respond to changing cargo demands.

Operational Challenges of Container Repositioning on Empty Container Storage

Table 1.3 Response on Operational Challenges of Container Repositioning on Empty Container Storage

Challenge type	Frequency	Percentage
Limited depot space	34	68
Delay in movement	35	78
Poor coordination	33	66
Ineffective tracking	30	60
Storage sufficient	Adequate and more	40
Staff impact	Significant	84
Infrastructure rating	Poor or very poor	36

Source: Field

The findings in Table 1.3 show that limited depot space is among the operational challenges observed. This challenge was noted by 68% of participants from the file, as they indicated insufficient depot capacity for the management and storage of containers at the Dar es Salaam Port as a strong challenge. At the Dar es Salaam facility, the rapid escalation in trade volumes has not been accompanied by a

corresponding enhancement of port infrastructure. Container depots frequently exceed their designated capacity, resulting in operational inefficiencies.

Similarly, delay in movement has been noted as one of the operational challenges, as it was revealed by 70% of survey participants. These delays are frequently attributable to intermodal inefficiencies, including inadequate coordination among road, rail, and port systems. In Dar es Salaam, trucks are often subjected to prolonged waiting times for the loading or unloading of containers, resulting in congestion both within and beyond the port gates. This result implied that delays in transportation lead to containers remaining within the port confines for extended durations, thereby occupying critical storage capacity. This accumulation obstructs the flow of goods, adversely impacting import-export timelines and escalating demurrage expenses.

Also, the study results revealed poor coordination among stakeholders as one of the operational challenges. This challenge was reported by 66% of respondents. The absence of real-time information exchange between port authorities, shipping lines, and inland transit companies is the root cause of these difficulties. This result signified that inadequate coordination results in misaligned container flows and scheduling conflicts. The transfer of containers may be delayed if they are stored in the incorrect depot zone or assigned to vehicles that are not available. The danger of operational errors increases in the absence of synchronized processes, which has a detrimental effect on total inventory accuracy and storage efficiency

Moreover, the study has observed that 60% of respondents identified inefficient tracking systems for container movements as one of the operational challenges in container storage. Container surveillance at the depots is still dominated by outdated software systems or manual techniques. Operational responsiveness at Dar es Salaam is hampered by the inadequate integration of tracking data with logistics management systems.

Furthermore, storage sufficiency was one of the operational challenges in container storage. This result was revealed by 40% of respondents surveyed thought that the existing storage capacity was adequate for operating requirements, but there was poor arrangement and handling of empty containers, which makes ineffective utilization of available space. This suggests that the majority of users believe the current planning and storage arrangement are insufficient to handle growing container quantities. The issue is made worse by outdated storage methods and poorly planned layouts.

The staff impact is another operational challenge observed in this study. The result has revealed that Repositioning efficiency is significantly influenced by workforce levels and competencies, which was affirmed by 84% of respondents. having skilled workers is crucial for ensuring accurate and timely container handling. Reports of understaffing and inadequate training programs for technical and logistical tasks are common at the port.

Lastly, the other operational challenge discovered was infrastructure quality. The study showed that 36% of respondents rated the port's infrastructure as poor, as an operational challenge. Issues that were frequently brought up included inadequate container handling equipment, poor road conditions, and antiquated IT infrastructure. Upgrades to accommodate higher throughput have not been made too many facilities. The poor port infrastructure results it implies that the port's operational capacity being limited, and container flow is slowed down by inadequate infrastructure. Inadequate facilities impede effective storage and repositioning by increasing turnaround times, causing equipment failures, and lowering service quality.

Strategies for Optimizing Empty Container Repositioning to Improve Container Inventory Management

Table 1.4 Response on Strategies for Optimizing Empty Container Repositioning to Improve Container Inventory Management

Strategy type	Utilization rate	Improvement rate
Forecasting tools	62	76% reported some or significant improvement
Partnering with LSPs	72	68% reported reduced shortage or surplus
Container leasing	58	-
Stakeholders collaboration	Good to excellent	60%

Source: Field,2025

The findings in Table 1.4 show that a significant proportion, specifically 62% of participants, reported the utilization of forecasting instruments to aid in the planning process and the prediction of container demand as one of the strategies. These instruments typically leverage historical trade statistics, port throughput metrics, seasonal shipping trends, and sophisticated analytical techniques to project container movements. Contemporary forecasting methodologies incorporate artificial intelligence (AI) and machine learning (ML) to enhance the precision of demand forecasts.

Also creating logistical partnerships, particularly with third-party logistics providers (3PLs), this was reported by 72% of survey participants as among of the strategy in improving inventory management. These collaborations optimize container transportation and storage by leveraging the expertise, resources, and networks of external suppliers. 3PLs often provide warehouse services, customs clearance assistance, and multimodal transportation options.

Furthermore, more than 58% of respondents reported using rental containers as one of the strategies for optimizing empty container reposting in improving inventory management instead of buying them. Businesses can utilize containers as needed, particularly in remote markets or during peak seasons. Large container pools are usually kept in strategic locations by leasing businesses, ready to be deployed in response to customer demands

Lastly, the study revealed that Stakeholder collaboration was evaluated as a positive element in repositioning efficiency by 60% of respondents. This calls for collaboration between inland transport companies, customs officials, terminal operators, and shipping lines. Digital platforms, cooperative ventures, and common performance goals all help to foster collaboration

CONCLUSION

This research elucidates that the container inventory management at the Port of Dar es Salaam is markedly impeded by the ineffective repositioning of empty containers, which frequently does not correspond with the actual inventory requirements across various regions. This disjunction leads to ongoing shortages and surpluses of containers, resulting in delays in export readiness, augmented storage expenditures, and discrepancies in inventory allocation. The difficulties are exacerbated by operational inefficiencies, which include sluggish container transit, insufficient depot capacity, antiquated monitoring technologies, inadequate coordination among stakeholders, a deficit in infrastructure, and a scarcity of skilled personnel.

While numerous strategic interventions, such as the implementation of forecasting methodologies, container leasing arrangements, enhanced logistics collaborations, and improved stakeholder engagement, exhibit potential in mitigating these challenges, they remain

insufficiently utilized and lack the requisite institutional backing for sustained execution. Consequently, a holistic and synergistic approach that incorporates these strategies into the operational framework of the port, bolstered by policy initiatives and capacity-building endeavors, is imperative for the enhancement of container inventory management and the overall efficiency of the port.

REFFERENCE

Flory, A. O. O., & Secretary, E. (n.d.). The overview of the Corridor Transport Observatory.

   https://www.ssatp.org/sites/default/files/inline-files/CCTO%20Presentation%20SSATP%2025th%20June%202024.pdf

Karunarathna, I., Gunasena, P., & Hapuarachchi, T. (2024). https://www.researchgate.net/profile/Indunil-

   Karunarathna/publication/383155577_Data_Collection_Fundamentals_A_Guide_to_Effective_Research_Methodologies_and

   _Ethical_Practices/links/66bee9928d00735592560ed5/Data-Collection-Fundamentals-A-Guide-to-Effective-Research-

   Methodologies-and-Ethical-Practices.pdf

Lapshin, A. (2023, July 18). Empty Container Repositioning: How to Increase Resilience and Flexibility. Transmetrics.

   https://www.transmetrics.ai/blog/empty-container-repositioning/

Malashchuk, D. V., & Hrynchak, N. A. (2018). Diagnosing and forecasting the prospects for the development of the global container

   transportation market. Naukovij Vìsnik Nacìonalʹnoï Akademìï Statistiki, Oblìku Ta Auditu, 3, 75–82.

Sáinz Bernat, N., Schulte, F., Voß, S., & Böse, J. (2016). Empty container management at ports considering pollution, repair options,

   and street-turns. Mathematical Problems in Engineering, 2016, 1–13.

Vinogradov, S. V., & Vyazovaya, D. A. (2022). Problems existing in global supply chains by sea container ships. VESTNIK OF

   ASTRAKHAN STATE TECHNICAL UNIVERSITY SERIES MARINE ENGINEERING AND TECHNOLOGIES,

   2022(2), 115–120.

Wang, G., Gunasekaran, A., Ngai, E. W. T., & Papadopoulos, T. (2016). Big data analytics in logistics and supply chain management:

   Certain investigations for research and applications. International Journal of Production Economics, 176(176), 98–110.
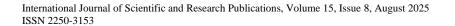
AUTHORS

Miriamu Nicodemo Benjamini

Department of Science and Management at Dar es Salaam Maritime Institute (DMI)

P.O. Box 6727, Dar es Salaam, Tanzania

Dr. Julieth Koshuma

Lecturer, Department of Science and Management at Dar es Salaam Maritime Institute

P.O. Box 6727, Dar es Salaam, Tanzania

Correspondence author: Miriamu Nicodemo Benjamini,miriben99@gmail.com, +255 684 637 973