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The Influence of Empty Container Depots on Container Repositioning in Tanzania: Implications for Port Efficiency

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ABSTRACT

Empty Container Depots (ECD) and container repositioning play pivotal roles in optimising the efficiency of global supply chains, especially within strategic facilities such as port terminals. **This study aims** to assess the influence of ECD on container repositioning within the context of Tanzanian ports. Specifically, it explores how ECD and repositioning processes are essential for managing container traffic and ensuring effective port operations in Tanzania. **Methods:** This study employed a survey design, targeting a population of 95 respondents. A stratified sampling technique was used to determine the sample size. Data were collected through questionnaires. Multiple regression analysis was employed to show the statistical relationships between the variables. **The results** revealed that investments in modern infrastructure and equipment at ECD significantly enhance container repositioning efficiency and reduce operational costs to alleviate congestion. The study underscores the importance of stakeholder collaboration in improving logistical performance. **The study recommends** improving the road network along transit routes to minimise delays in transporting empty containers.

***Keywords**:* empty container depots; infrastructure; stakeholders; repositioning; port efficiency; Tanzania

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ОРИГИНАЛЬНАЯ СТАТЬЯ

Влияние складов пустых контейнеров на перемещение контейнеров в Танзании: последствия для эффективности порта

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АННОТАЦИЯ

Склады пустых контейнеров (СПК) и перемещение контейнеров играют ключевую роль в оптимизации эффективности глобальных цепочек поставок, особенно в рамках стратегических объектов, таких как портовые терминалы. **Цель** данного исследования — оценить влияние СПК на перемещение контейнеров в контексте портов Танзании. В частности, в нем рассматривается, насколько процессы СПК и перемещения контейнеров важны для управления контейнерными перевозками и обеспечения эффективной работы портов в Танзании. В данном исследовании использовался **метод** опроса, в котором приняли участие 95 респондентов. Для определения размера выборки использовался метод стратифицированной выборки. **Данные** были собраны с помощью анкетирования. Для демонстрации статистических связей между переменными использовался множественный регрессионный анализ. **Результаты** показали, что инвестиции в современную инфраструктуру и оборудование СПК значительно повышают эффективность

перемещения контейнеров и снижают эксплуатационные расходы, что позволяет избежать перегрузок. Исследование подчеркивает важность сотрудничества заинтересованных сторон в улучшении логистических показателей. Исследование **рекомендует** усовершенствовать дорожную сеть вдоль транзитных маршрутов, чтобы минимизировать задержки при транспортировке пустых контейнеров.
Ключевые слова: склады пустых контейнеров; инфраструктура; заинтересованные стороны; перемещение контейнеров; эффективность порта; Танзания

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1. Introduction

Empty container repositioning (ECR) is one of the most significant subjects in the liner shipping industry [1]. ECR has both economic effects on the stakeholders in the container transport chain and environmental sustainability impacts on humanity. ECR lessens empty container schedules and, henceforward, reduces fuel consumption, overcrowding, and emissions. Additionally, Empty Container Depots (ECD) play a crucial role in the repositioning of containers in ensuring the containers are sent where required at a particular time. Moving empty containers costs the industry more than $ 20 billion every year. That's more than 12% of operating costs for shipping lines [2].

Inland transport of cargo and empty containers plays a key role in the efficiency of global supply chains, particularly at strategic facilities such as port terminals, intermodal rail stations, warehouses, or customs storage areas. The container transport chain starts when the shipping company takes empty containers from their depot to be loaded by the consignor. Every third container being moved is empty. That's at least 60 million empty container moves every year. To break the numbers down even further, 170 million containers are being moved around the world via different methods of freight transport, and of that number, an additional 50 million containers are empty.

In response to reducing pressure and as a decongestion strategy for major ports, the development of dry port concepts such as Empty Container Depots (ECD) has been initiated to assist the operational performance of prime ports [1].

There has been an increase in the need for ECD to reduce cargo congestion at the port [3]. However, less has been done by extant studies on how ECD influences container repositing; therefore, this study intended to assess how ECD has an influence on container repositing by employing ECD infrastructure, ECD stakeholder perspective and ECD handling equipment.

2. Literature review

2.1. Theoretical foundation

Empty container repositioning (ECR) is the movement of empty containers from an area with a surplus of containers to a location with a deficit. Additionally, ECR is the last movement in intermodal freight transportation of containers in door-to-door shipments, where empty containers are returned to depots or moved to shippers for exportation [4]. Containers can either be returned to a depot for storage in the hinterland of a port or directly to the port depot for global repositioning. Furthermore, empty repositioning can refer to the movement of empty containers between inland depots, port depots, or port terminals to decrease empty container imbalance [5].

It has been noted that international trade has been a key factor in developing world economies, increasing the need for efficient supply chains to distribute products and services in global markets. "Although the responsiveness of trade to the Gross Domestic Product (GDP) growth has been moderate over the recent years, demand for maritime transport services and seaborne trade volumes continues to be shaped by global economic growth and the need to carry merchandise trade" [1].

This study has been guided by two theories (the street turns theory and stakeholders' theory). The essence of using two theories is to overcome one theory's weaknesses and increase the likelihood of having many constructs to explain the problem under investigation.

A street turn theory expounds on an operational strategy that shortens the distance travelled to a port terminal. Instead of returning an import container stripped at a consignee/importer to a port terminal, the empty container is directly transported to a shipper/exporter, stuffed with export cargo there, and subsequently transported to a port. Finding an export request for an imported container before it returns to the port is referred to as a match-back, resulting in a container's street turn. That strategy eliminates two types of empty container movements from the importer to the terminal and from the terminal to the exporter while adding only one empty container movement, namely between the importer and the exporter [6].

From a local and regional perspective, the street turns reduce the number of empty trips and thereby the distance travelled by trucks [6]. The study [7] on empty container repositioning in ports concluded that street turns can significantly reduce costs and congestion, hence emissions, noise, and drive times for truck drivers, all depending on the geographical proximity between the importer and the exporter. However, identifying suitable street turns is quite difficult.

Existing studies reveal several barriers to street turns, including timing and location mismatch, ownership mismatch, container type mismatch, and legal issues [6–8]. Identifying suitable situations with geographical proximity also complicates street turns due to the trade imbalances that exist between regions that are usually import- or export-dominated. Further barriers include limited free time, repair charges, inconsistent procedures for interchange, inspection and paperwork requirements, and commercial, insurance, and liability hurdles [5]. Studies in the literature have mostly approached street turns from the perspective of shipping lines [6]. More recently, however, [9] has considered the perspective of the importer[1].

Stakeholder theory, on the other hand, emphasises the view of capitalism that stresses the interconnected relationships between a business and its customers, suppliers, employees, investors, communities and others who have a stake in the organisation [10]. The stakeholder approach identifies and models the groups that are stakeholders of a corporation, and both describes and recommends methods by which management can give due regard to the interests of those groups. "A *stakeholder is any individual or group of individuals that can influence or be influenced by the achievement of the organisation's objectives"*. The theory argues that a firm should create value for all stakeholders, not just some shareholders. The stakeholder approach is well applied in both seaports and dry ports studies and identifies some of the stakeholders with their interests.

The study [11] categorised these stakeholders into three main groups based on various interests, i.e., seaport-based players, dry port users, and the community. The seaport-based group includes port operators and port authorities. These players' interests are to expand their seaports' hinterland to further inland locations. Dry port users include shipping lines, local shippers, logistics providers, economic zone operators, transporters, and forwarders, which tend to enhance logistics performance for cargo movements between seaports and the local economic areas, and the community has an interest in the regional social economy impacts of dry port operations such as regional trade development, traffic congestion and accident rates, job creation and environmental issues. In the context of this study, stakeholders are ECD users, including clearing and forwarding agents and shipping line companies that receive services to enhance their access to maritime and minimise operational costs. As each stakeholder group has an interest in dry port development, it is necessary to have a framework to evaluate their various benefits in empty container repositioning. Therefore, the street turns theory and stakeholders' theory form a basis to study how ECD relates to ECR to enhance port operations.

2.2. Empirical perspective

The review of empirical literature was based on ECD infrastructure, empty container repositioning, ECD stakeholders' perspectives, and ECD handling equipment.

2.2.1. ECDs infrastructure

Container depot infrastructure significantly influences empty container repositioning processes by providing temporary storage, examination facilities, and centralised documentation handling, facilitating efficient empty container repositioning. For instance, the study [12] highlights the importance of integrated port and logistics infrastructure in enhancing supply chain efficiency and competitiveness, emphasising the role of container depots as crucial nodes for customs clearance activities. By offering secure storage spaces and examination facilities, emp-

[1] UNESCAP. Guidelines for Port Stakeholders: Managing for Efficiency. Bangkok: UNESCAP; 2017.

ty container depots enable depot authorities to conduct inspections and repairs.

Furthermore, when a container has been returned to a depot, it must be inspected before being reused for an export shipment [13]. Inspection of empty containers is carried out to categorise and assess the quality or cleanliness of the container. Containers can be either operational and ready for reuse or damaged and in need of repairs [14]. Hence, contributing to the smooth flow of goods across borders. Overall, container depot infrastructure plays a vital role in optimising the repositioning of empty container processes, ensuring compliance with import/export regulations, and facilitating seamless trade operations within global supply chains. Generally, port infrastructure is divided into physical and soft elements. Physical infrastructure includes not only the operational facilities, such as the number of cranes, yards, and the area of storage space, but also transport, such as roads and railways. Whereas, the soft infrastructure refers to the manpower employed. Maximum deployment of both types will assist in reducing truck turnaround, thereby increasing the terminal capacity to accommodate more containers. Ships are continually increasing their carrying capacity, and containers made for large transport units in overseas container transport are under consideration. This scale enlargement requires new and capital-intensive transshipment facilities in gateway ports. Particularly, intermodality is essential for the speedy transport of cargo into and out of a gateway port. Without proper linkages, the efficiency of container terminal operations may decline due to congestion and delays [8]. The study [15] on reducing redundant empty container repositioning indicated that container repositioning relates to the role played by seaports and inland terminals' infrastructure in reducing cargo congestion at the seaport. The empirical findings recounted that the role of seaports and inland terminals is largely to facilitate intermodal transport. Supplementary, several stimuli and barriers for reducing empty container repositioning were identified. Therefore, we hypothesise that ***Ha1****: ECD infrastructure positively influences container repositioning.*

2.2.2. ECDs stakeholders' perspectives

Stakeholder cooperation serves as the glue that supports organisational workflow and operational efficiency. A stakeholder is a party interested in a company and can either affect or be affected by the business [16]. According to the international standard guiding social responsibility, ISO 26000, a stakeholder is defined as an individual or group that has an interest in any decision or activity of an organisation. Numerous parties are engaged in the dry ports in Tanzania. These parties must pull together towards a unified goal of supporting optimal port performance to avoid conflicts and inefficiencies. This study will examine the involvement of the various stakeholders, namely the Government of Tanzania, clearing and forwarding agents, port operators, terminal operators, the Tanzania Ports Authority, and shipping line companies in empty container depots in Tanzania.

Studies reveal that stakeholders have diverse interests in efficiently managing empty containers, impacting port congestion, transportation costs, and environmental sustainability [17]. Effective stakeholder engagement strategies are crucial for managing depot operations and addressing concerns such as land use, noise pollution, and traffic congestion while promoting sustainable practices and enhancing operational efficiency [18]. Research emphasises the need for collaborative governance frameworks and policy interventions to optimise depot utilisation, mitigate environmental impacts, and ensure equitable distribution of benefits among stakeholders [19]. Case studies highlight successful practices in stakeholder collaboration and regulatory frameworks that facilitate the integration of empty container depots into broader port logistics strategies.

The results from the study [20] on improved transport efficiency through reduced empty positioning of containers — transport buyers' perspective — revealed that Empty Container Depots (ECD) stakeholders such as freight forwarders have proven to play an important role in reducing empty container repositioning among the transport buyers mainly because of their knowledge within container transport management. ECD stakeholders play a substantial role in reducing cargo congestion at the port by managing the empty containers to be used from surplus to deficit areas. From these arguments, we hypothesise that ***Ha2:*** *ECD stakeholders' perspective positively influences container repositioning.*

2.2.3. ECDs handling equipment

Container handling equipment is one of the important operations for container terminal logistics, which involves loading a container from a truck to a vessel or unloading a container from a vessel to a truck [21]. Several major container terminal operations influence the efficiency of the container terminal, which include the vessel berthing operation, the crane unloading/loading operation, the container delivery operation by trucks, the inspection operation, and the container storage operation. The crane operation is the key factor that determines the efficiency and effectiveness of a container terminal [22]. When a container vessel is moored at berth, several cranes are arranged to load or unload containers for that vessel. Unloaded containers are transported by trucks and then go through other terminal operations. After finishing all unloading jobs, cranes will start loading containers from the land side onto the container vessel [22].

Improved container handling systems attract larger tonnage, thereby offering competitive international transport distribution services. Failure to improve container handling systems will encourage ship owners and shippers to use other ports with full operational capacity due to the absence of underutilisation resulting from low mechanisation, manual handling, and improper cargo handling equipment [3].

According to [8], one of the most basic requirements of any organization is to be able to transport or move materials, equipment and spare parts from one point to another. Material handling is of vital importance and is indicated by the range and high cost of the equipment that each organization has. Handling materials, which is a major activity in storehouses and stockyards, is a costly operation, and therefore the methods and equipment should be efficient. Poor equipment handling leads to shoddy work, making an organization unable to handle the required load on time, causing delays, congestion, and inefficiencies along the supply chains. A study conducted by [21] examined the impacts of cargo handling equipment on government revenue collection, a case of the Tanzania Ports Authority (TPA). The results showed a relationship between cargo-handling equipment and government revenue collection. That is, cargo handling equipment affects government revenue collection positively. Therefore, we hypothesise that ***Ha3***: *ECD handling equipment positively influences container repositioning.*

2.2.4. Empty container repositioning

Empty container repositioning, also known as container redistribution, is the process of moving empty shipping containers to locations where they are needed. This is necessary because containers often end up in locations where there is less demand for imports compared to exports, leading to imbalances in container availability. Repositioning helps to ensure that containers are available in the right places to meet the demand for shipping goods. It's a crucial aspect of global logistics management, aimed at optimising container utilisation and reducing costs in the shipping industry.

Empty container repositioning is a fundamental concept in maritime logistics and supply chain management, extensively discussed in academic literature and industry publications (see *Fig. 1*) [23].

Variables for ECD infrastructure include transport, storage capacity, and ICT system. Variables from ECD stakeholders' perspective include: logistics providers, importers and exporters, and depot operators and variables for ECD handling equipment are unloading and loading, automated mechanics, and modern equipment.

3. Material and methods

A survey research design was used by this study due to its ability to produce statistical information about aspects of ECD influence and its impact on empty container repositioning. Data were collected at once (cross-sectional time horizon). The use of survey design was of paramount significance due to its suitability to ensure minimum bias and maximum reliability of the evidence collected. Data collected quantitatively enabled the researchers to generalise findings from samples to populations, test hypotheses, and make predictions based on data analysis [24]. Study [25] defines a population as an entire group of people or things of interest that the researcher aims to assess. Additionally, [26] presumes a population is an entire group of individuals or objects having common observable characteristics.

3.1. Study participants

The target population is specified as a large group of many cases from which a researcher

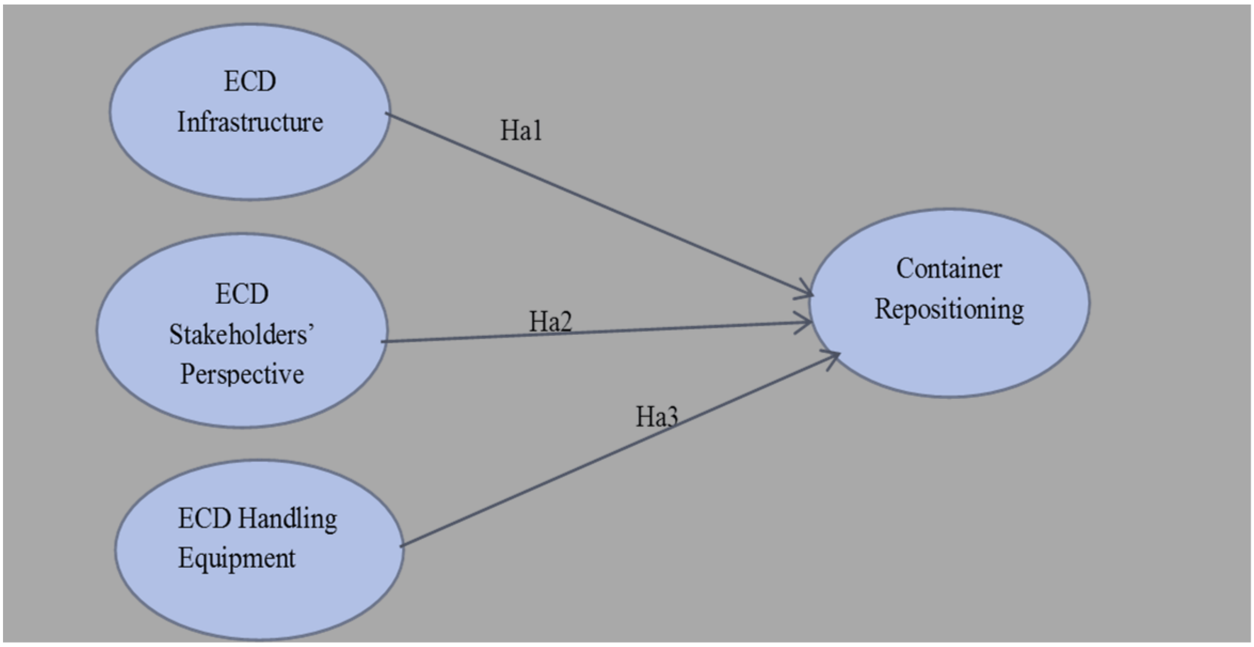

Fig. **Conceptual model of the study**

Source: Authors' conceptualisation from literature and theories.

draws a sample, and to which results from the sample are generalised. The target population for this study covered three groups of respondents identified as shipping line companies based on ECD operations of 20 major companies in Tanzania, 70 clearing and forwarding agents, and 5 companies registered both as shipping lines and clearing and forwarding, based on Fantuzzi and Kurasini empty container depots.

A stratified random sampling was used, through which the researcher identified the target population and then defined the criteria for stratification. Respondents were chosen randomly from the strata based on sample size to give an equal probability [27]. This sampling technique was used because it has a minimal sampling error. All based on Fantuzzi Investment Ltd and Kurasnini Container Terminal CFAs had equal chances to participate in the study. The sample size was computed by solving a formula to draw the sample size [28–29].

$$n = \frac{N}{\left(1 + Ne^2\right)}$$

n = sample size, N = population size, e = error, Confidence level = 95% p- value = 0.05

Then; Sample size, $n = \frac{95}{\left(1 + 95\left[0.05^2\right]\right)} = 77.$

Therefore; the total sample size used is 77.

The above assessments are based on Slovin's formula for sampling technique.

3.2. Data collection procedures and analysis

The questionnaire (Appendix 1) was applied to collect data in which closed-ended questions on a Likert point scale ranging from 1 to 5 were involved. To increase the understanding of the problem and create a logical base for the research gap, researchers have to review other documents such as books, laws, regulation papers, conference reports and theses. The purpose of reviewing previous studies was grounded on generating concepts and theoretical knowledge available and preparing research instruments and field observation.

Data were analysed descriptively, and to some extent, a multiple linear regression technique was adopted to provide statistical significance on the relationship between independent variables and dependent variables. Descriptive and inferential statistics were used to analyse the data. Descriptive statistics include percentages, frequency distribution and measures of central tendencies (mean). The data was presented in the form of tables, graphs and charts. Inferential statistics was used out of the fact that sampling naturally incurs sampling error, and thus a sample

Table 1
Gender of Respondents

Gender		Frequency	Per cent
Valid	Male	61	79.2
	Female	16	20.8
	Total	77	100.0

Source: Authors' field data, 2024.

Table 2
Levels of education of the respondents

Education		Frequency	Per cent
Valid	Masters' Degree	17	22.1
	Bachelor's degree	50	64.9
	Diploma	9	11.7
	Certificate	1	1.3
	Total	77	100.0

Source: Authors' field data (2024).

is not expected to perfectly represent the population. The methods of inferential statistics were used to estimate the parameter(s) and the testing of statistical hypotheses. Data (Appendix 2) were analysed using the IBM SPSS Statistics version 20.

4. Results and discussion

This part describes the results and links the findings with the previous empirical studies.

4.1. Respondents' profiles

This section provides an overview of the study respondents' profiles in their respective fields. It is described using respondents' profiles, which include the variables for gender, education level and field of work of respondents, respectively.

4.1.1. Gender of the respondents

The study collected data on the gender of the respondents of the study. *Table 1* shows the results as follows.

The findings in *Table 1* reveal that 79.2 percent of the respondents are male, while 20.8 percent of the respondents are female. This asserts that many respondents involved in this study were males. This is because women make up a small fraction of the workforce in the logistics and supply chain sector. Globally, women comprise only about 2% of seafarers, reflecting deep gender imbalances within the shipping industry [30]. Similarly, in freight forwarding, only 16% of placements were female across Europe, Africa, and Asia [31]. The barriers for women include not only traditional gender roles but also industry-specific challenges, such as physical demands and long hours, which are perceived as unsuitable for women in conservative societies [32].

4.1.2. Level of education of the respondents

The study collected data on the level of education of respondents of the study (*Table 2*).

The findings in *Table 2* show that 22.1 percent of the respondents had a master's degree, 64.9 percent of the respondents had a bachelor's degree, 11.7 percent of the respondents had a diploma, and 1.3 percent of the respondents had a certificate. This makes the total number of 77 respondents (100 percent). The results show that the logistics sector in Tanzania employs people with all levels of education. The findings further indicate that a large number of respondents of this study have bachelor's degrees, 50 (64.9%).

Recent research demonstrates that bachelor's degree holders, particularly in supply chain management and logistics, predominate in the shipping line, clearing, and forwarding industries. Because of the complexity of international trade and the necessity for a specialist understanding of customs, freight operations, and compliance, a degree in these subjects is becoming an increasingly important prerequisite. Furthermore, the

Table 3
Field of work of respondents

Field of work		Frequency	Percent
Valid	Clearing and forwarding	59	76.6
	Shipping Line	15	19.5
	Clearing and forwarding	3	3.9
	Total	77	100.0

Source: Authors' field data (2024).

Table 4
Descriptive statistics

Variables	N Statistic	Min Statistic	Max Statistic	Sum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness Statistic Std. Error	Kurtosis Statistic	Std. Error
ECD_ Infrastructure	77	1.00	5.00	274.00	3.5584	0.90715	−0.367 0.274	−0.221	0.541
ECD _Stakeholders' Perspective	77	1.33	5.00	297.67	3.8658	0.087067	−1.164 0.274	1.055	0.541
ECD_Handling Equipment	77	1.00	5.00	288.67	3.7489	0.87218	−0.548 0.274	0.245	0.541
Empty_ Container_ Repositioning	77	2.00	5.00	293.67	3.8139	0.86601	−0.322 0.274	−0.931	0.541
Valid N (Listwise)	77								

Source: Authors' field data (2024).

introduction of specialised degrees, such as the Bachelor of Commerce in Freight Forwarding and Customs Compliance, emphasises the importance of academic qualifications in professionalising the sector [33].

4.1.3. Field of work of respondents

The study collected data on the field of work of respondents. *Table 3* shows the results as follows.

The findings in *Table 3* show that 76.6% of the respondents work in clearing and forwarding, 19.5% of the respondents work in shipping lines, and 3.9% of the respondents work in both shipping lines and clearing and forwarding. Clearing and forwarding provides 59 (76.6%) respondents this is because Tanzania has a significantly higher number of employees in the clearing and forwarding sector compared to the shipping line sector. According to the Tanzania Freight Forwarders Association (TAFFA), there are over 1,000 licensed clearing and forwarding companies operating within the country, representing a large workforce across various roles within these firms. This contrasts with the relatively smaller number of shipping line companies, which primarily focus on the actual transportation of goods but involve fewer direct operations compared to the extensive processes handled by clearing and forwarding firms.

4.2. Analysis of the variables under study

Variables are analysed to show their relationships, and the hypotheses are tested to show the significance level. Under this part, descriptive and inferential analyses have been shown to show the nature of the respondents and test the hypotheses. The analysis is established to explain the predictor having greater influence on the dependent variable over others using the mean and also the lowest level of respondents' opinion using the standard deviation.

This descriptive analysis provides an overview of the tendencies in respondents' perceptions of the various factors influencing empty container

Table 5
Normality test

Variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Dif.	Sig.	Statistic	Dif.	Sig.
ECD_Infrastructure	0.162	77	0.44	0.964	77	0.027
ECD_Stakeholders' Perspective	0.276	77	0.000	0.865	77	0.000
ECD_Handling Equipment	0.138	77	0.001	0.944	77	0.002
Lilliefors Significance Correlation						

Source: Authors' survey data, 2024.

repositioning. These findings suggest that most respondents view the handling and repositioning processes favourably, although there is some variability, particularly in the assessment of infrastructure. The findings in *Table 4* show that the average scores for each component (infrastructure, stakeholder perspective, handling equipment, and repositioning) are reasonably high (ranging from 3.56 to 3.87). ECD Infrastructure exhibits the greatest diversity in responses (highest standard deviation), suggesting that respondents' perspectives on infrastructure were more varied.

ECD Infrastructure, ECD Handling Equipment, and Empty Container Repositioning show skewness and kurtosis values that are reasonably close to 0; that is variables are fairly close to a normal distribution. ECD Stakeholder Perspective shows more deviation from normality, with higher negative skewness and a positive kurtosis, indicating a more asymmetrical and peaked distribution. Given the standard errors of skewness (0.274) and kurtosis (0.541), most of the variables have values within an acceptable range, suggesting that their distributions are not significantly different from normal.

4.2.1. Preliminary tests

Numerous tests can be conducted to support causal relationship testing, including a normality test, a multicollinearity test, and a heteroscedasticity test. They are discussed below:

4.2.1.1. Normality test

To ascertain whether a collection of data has a normal distribution, a normality test is utilised. Many statistical analyses used in research (including ANOVA, t-tests, and regression) include the assumption that the data are normally distributed. Testing for normalcy is crucial in this investigation of empty container repositioning and its relationships to variables like ECD Infrastructure, ECD Stakeholder Perspective, and ECD Handling Equipment.

The Kolmogorov-Smirnov and Shapiro-Wilk tests, two measures of normalcy, are displayed in the Tests of Normalcy table. The findings in *Table 5* indicate that Kolmogorov-Smirnov and Shapiro have p-values less than 0.05 for each of the three variables (ECD Infrastructure, ECD Stakeholder Perspective, and ECD Handling Equipment). This shows that the data was drawn from probability sampling.

4.2.1.2. Multicollinearity test

When two or more independent variables exhibit strong correlations, the model's information is redundant or overlapping, a phenomenon known as multicollinearity. *Table 6* illustrates the results.

The results indicate the outcome of collinearity and multicollinearity tests. The Variance Inflation Factor (VIF) describes the multicollinearity test; if the values for the variance inflation factor are less than five (5), it implies that variables do not exhibit a multicollinearity problem. The findings in Table 6 show that all variables are far from the collinearity level, as the values are less than the critical value of 5.

4.2.2. Inferential analysis

This kind of analysis is designed to describe the relationship between predictors and dependent variables, through correlation and multiple regression analysis, with the model summary test as a key indicator for the predictors' overall impact on the dependent variable (*Table 7*).

The findings in *Table 7* indicate that the independent variables (ECD Stakeholder Perspective,

Table 6
Multi-collinearity test

Coefficients								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.417	.352		1.182	.241		
	ECD_Infrastructure	.329	.085	.344	3.889	.000	.752	1.329
	ECD_Stakeholder_ Perspective	.274	.101	.275	2.713	.008	.572	1.748
	ECD_Handling_ Equipment	.312	.096	.314	3.266	.002	.637	1.570
a. Dependent Variable: empty container_repositioning								

Source: Authors' survey data, 2024.

Table 7
R-squared and Adjusted R-squared

Model Summary				
Model	R	R Square	Adjusted R-Square	Standard Error of the Estimate
1	.755a	.570	.552	.57962
a. Predictors: (Constant), ECD_Handling_Equipment, ECD_Infrastructure, ECD_Stakeholder_Perspective				

Source: Authors' survey data.

Table 8
Analysis of variance (ANOVA)

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.473	3	10.824	32.220	.000b
	Residual	24.525	73	.336		
	Total	56.999	76			
a. Dependent Variable: Empty container repositioning						
b. Predictors: (Constant), ECD handling equipment, ECD infrastructure, ECD stakeholders' perspective						

Source: Authors' field data (2024).

ECD Infrastructure, and ECD Handling Equipment) have a good association (R = 0.755). The R-squared = 0.570 implies that 57% of the variation in the dependent variable is explained by the independent variables included in the model. The adjusted R-square is 0.552, which is slightly lower than the R-square (0.570). This suggests that while the model explains 57% of the variance, some of the explanatory power may be due to the number of variables rather than the quality of the predictors.

Further, the adjusted R-squared shows that the model loses some of its explanatory power when accounting for the number of predictors and the sample size. In other words, the predictive power of the model is still strong, but a small portion of the variability explained by the model could be due to the number of predictors rather than the actual quality of the predictors. Suggesting that the model fits the data reasonably well. The residuals, or errors, appear to be moderately distributed around the projected values, based

Table 9
Correlation analysis

Variables		ECD_ Infrastructure	ECD_Stakeholders	ECD _Handling_ Equp
ECD_Infrastructure	Pearson Correlation	1	.475**	.262*
	Sig. (2-tailed)		.000	.021
	N	77	77	77
ECD_Stakeholders	Pearson Correlation	.475**	1	.349**
	Sig. (2-tailed)	.000		.002
	N	77	77	77
ECD Handling_Equp	Pearson Correlation	.262*	.349**	1
	Sig. (2-tailed)	.021	.002	
	N	77	77	77

Source: Authors' field data (2024).

Note: * Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

on the standard error of 0.57962. Overall, there is still space for unexplained variation or other contributing factors, but the regression model shows a good fit overall, with the predictors accounting for a sizable percentage of the outcome's variance. The model is further tested through an analysis of variance (ANOVA) test, with the results shown in *Table 8*.

The findings in *Table 8* indicate that the regression model is statistically significant ($p < 0.001$), meaning that the independent variables together significantly explain the variation in Empty Container Repositioning. The high F-value (32.220) suggests the model has strong predictive power. Therefore, the variables ECD Infrastructure, ECD Stakeholder Perspective, and ECD Handling Equipment are useful predictors in explaining the efficiency of empty container repositioning in Tanzania. As such, the results support the study's claims that infrastructure, stakeholder perspectives, and equipment handling play key roles in improving empty container logistics.

4.2.2.1. Correlation analysis

This analysis is conducted to describe the predictor that best correlates with the dependent variable. Other factors, due to the data characteristics, Spearman's correlation is best suited for this task. *Table 9* shows the results as follows.

The findings from *Table 9* show that there is no harm between variables. Variables do not correlate at a 95% confidence interval (5%) level of significance; all variables are out of collinearity level. This helps avoid **multicollinearity**, which occurs when two or more independent variables are highly linearly related.

The Spearman's rho correlation table shows the strength and direction of the association between the variables (ECD Infrastructure, ECD Stakeholder Perspective, ECD Handling Equipment, and Empty Container Repositioning) and whether these correlations are statistically significant. With p-values less than 0.001, all correlations are statistically significant and positive, indicating that the associations do not result from random chance. Empty container repositioning and ECD infrastructure had the strongest association (rho = 0.619), suggesting that infrastructure is crucial to increasing empty container repositioning efficiency. Additionally, significant correlations (rho = 0.610 and rho = 0.615) between ECD Handling Equipment and Empty Container Repositioning and ECD Stakeholder Perspective, respectively, demonstrate the significance of both equipment and stakeholder perspectives in the repositioning process. This implies that raising the ECD infrastructure, stakeholder perspective, and handling equipment standards will probably increase empty container repositioning's efficacy and efficiency.

Table 10
Multiple regression analysis

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.417	.352		1.182	.241
	ECD_Infrastructure	.329	.085	.344	3.889	.000
	ECD_Stakeholder_ Perspective	.274	.101	.275	2.713	.008
	ECD_Handling_Equipment	.312	.096	.314	3.266	.002
a. Dependent Variable: Empty_Container_Repositioning						

Source: Authors' survey data, 2024.

4.2.2.2. Multiple regression

The analysis is conducted to explain the individual influence of each predictor on the dependent variable. The results are shown in *Table 10*.

The Coefficients table from the multiple regression analysis provides information on the contribution of each independent variable (predictor) to the dependent variable (outcome). All three predictors (ECD Infrastructure, ECD Stakeholder Perspective, and ECD Handling Equipment) have a statistically significant, positive relationship with Empty Container Repositioning ($p < 0.05$ for each predictor). This means that the model suggests that infrastructure has the strongest effect on improving empty container repositioning efficiency, followed by handling equipment and stakeholder perspectives. Also, all three factors are statistically significant, meaning that investment in these areas will likely improve the efficiency of empty container repositioning processes.

5. Discussion of the findings

The study found that ECD (Empty Container Depots) infrastructure has a significant positive influence on empty container repositioning ($\beta = 0.344$, $p < 0.001$). This finding aligns with existing literature that underscores the critical role of robust port and depot infrastructure in ensuring the efficient movement of containers [34]. The correlation analysis also revealed a strong positive relationship (Spearman's rho = 0.619), indicating that improvements in infrastructure, such as better storage facilities, transportation linkages, and depot systems, can significantly enhance the efficiency of empty container repositioning.

The correlation analysis results suggest that improving ECD infrastructure will impact forecasting and planning: Understand the relationship between container availability and import or export volumes. For instance, if higher port throughput correlates with lower container lodge times at ECDs, resources can be changed accordingly. The correlation results also affect cost efficiency, which is the relationship between transport distance, fuel cost, and container turnaround time.

The correlation results between ECD handling equipment, infrastructure and container repositioning are essential in inventory management, as they are used in discovering patterns between empty returns, maintenance cycles, and reutilization rates.

These findings are consistent with those of [15], who highlighted that seaport and inland terminal infrastructure are strongly correlated with the reduction of cargo congestion at seaports. Therefore, we accept the alternative hypothesis (Ha1) that ECD infrastructure positively influences container repositioning.

The significance of physical infrastructure is further emphasised by [35], who recommended that ports and container depots equipped with advanced facilities, such as modern storage areas and seamless transport links, are better positioned to meet the rising demand for containerised goods. In the context of Tanzania, improvements in depot infrastructure have substantially reduced congestion and enhanced the efficiency of repositioning processes [3].

Additionally, the study found that the ECD stakeholder perspective significantly influences empty container repositioning ($\beta = 0.275$, $p = 0.008$). This result is under stakeholder theory, which posits that effective engagement with stakeholders is vital for the smooth functioning of port operations. A moderately high positive correlation (Spearman's rho = 0.610) was observed between stakeholder perspectives and the efficiency of empty container repositioning. Previous studies, such as those conducted by [11], have highlighted the importance of stakeholder collaboration in improving logistics efficiency. In Tanzania, improved relationships between shipping lines, port authorities, and logistics providers were found to enhance coordination and decision-making, which, in turn, leads to more efficient container movements. As emphasised by [20], fostering strong stakeholder relationships reduces delays and streamlines container repositioning, benefiting the entire supply chain. The alternative hypothesis (Ha2), which posits that the ECD stakeholder perspective positively influences container repositioning, is therefore accepted. These results are consistent with previous research, including [23, 5, 14–18], which supports the view that stakeholder input in ECDs and maritime logistics aids in minimising the total costs associated with empty container movements. By leveraging stakeholder perspectives, shipping line agents can optimise the sequence for container movement, further improving the repositioning process.

Finally, the study found that ECD handling equipment plays a significant role in empty container repositioning ($\beta = 0.314$, $p = 0.002$), with a strong positive correlation (Spearman's rho = 0.615). This is in agreement with [26], who noted that modern, well-maintained handling equipment is essential for efficient port operations. In the Tanzanian context, the availability of advanced equipment, such as cranes, forklifts, and automated systems, has been shown to reduce turnaround times, thereby enhancing repositioning efficiency. The study [24] also supports this finding, emphasising that effective handling equipment reduces congestion and minimises delays, making the repositioning process smoother. This study further confirms that investments in state-of-the-art equipment at depots such as Fantuzzi and Kurasini positively impact the efficiency of empty container logistics. The findings of this study underscore that ECD infrastructure, stakeholder perspectives, and handling equipment are critical factors influencing empty container repositioning in Tanzania. Each of these factors plays a significant role in improving the efficiency of container logistics, and investments in these areas can result in more streamlined and cost-effective repositioning processes.

6. Conclusion and recommendation

This study aimed to determine how Empty Container Depots (ECDs) and repositioning processes contribute to improving port operation efficiency by examining three variables: ECD handling equipment, stakeholder perspectives, and ECD infrastructure. The findings indicate that all three variables significantly influence the efficiency of container repositioning. These results highlight the vital role of ECDs in supporting national customs activities and improving port operations, including key functions such as tax collection, job creation, and enhancing professionalism and expertise. Given these findings, the following recommendations are made:

Training and development: Continuous training is essential for stakeholders involved in the empty container repositioning process to remain updated on technological advancements. This can be achieved through training workshops, seminars, and online learning. Stakeholders should be regularly trained on improvements in the systems used to clear documents, such as the Single Window System for cargo clearance, which has incorporated additional modules to enhance efficiency

Maintenance of handling equipment: Handling equipment, which includes mechanical equipment used for the movement, storage, control, and protection of empty containers, should undergo regular maintenance to prevent breakdowns. This will reduce depot delays and ensure smooth operations during repositioning.

Improved road networks: The development of better road infrastructure along designated transit routes will significantly enhance the efficiency of container terminals by reducing delays experienced by trucks transporting empty containers to and from depots.

7. Implications of the findings

The practical implications of this study suggest that companies and stakeholders involved in logistics in Tanzania should prioritise infrastructure development and modernisation of equipment while fostering strong collaboration to improve container repositioning. Existing studies have explored various optimisation models and algorithms to improve repositioning strategies; however, this study contributes to policymaking by demonstrating that the integration of ECD handling equipment, stakeholder perspectives, and infrastructure can enhance container repositioning through real-time data analytics and predictive modelling, leading to better decision-making and overall performance in container logistics.

By improving the ECD infrastructure, using old or traditional ECD models like Ports overwhelmed, ECD over-capacitated, or underutilised, Manual processes and a **lack of coordination** with ports, shipping lines, and inland transport can be minimised or discouraged. Instead, ECD infrastructure can lead to digitalised or smart ECDs that increase visibility of container status (location, condition, availability), reducing idle time and repositioning costs.

Improving ECD stakeholders through regionalised & planned placement that can help the use of modern models, data-driven location selection for depots, optimising proximity to shippers, importers, and key logistics hubs and minimising "dead-haul" miles and reducing environmental impact. Integration with Logistics Network: ECD can be combined into wider logistics and intermodal networks, serving as provisional warehousing, customs clearance zones, or transshipment hubs. Sustainability and Circular Economy: By reducing unnecessary repositioning and supporting green logistics, ECD contributes to the reduction of carbon emissions.

Theoretically, this study extends both the street turn theory and stakeholder theory by suggesting the collection of qualitative data and the integration of these two theories. The combination of theories helps address the complexity of the problem by providing sufficient variables for analysis. This study integrates the two theories, tests variables related to container repositioning in Tanzania, and identifies potential variables that policymakers can use to reduce cargo congestion at ports.

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APPENDICES

Appendix 1: Questionnaire

This questionnaire is for the study titled "***The Influence of Empty Container Depots on Container Repositioning in Tanzania: Implications for Port Efficiency"***

SECTION A: Demographic Information
Answer all questions as indicated by ticking the correct answer.
Gender
Male [] Female []
Highest level of Education and training attained?
Master's Degree [] Bachelor's Degree [] Diploma [] Certificate []
Which of the following areas do you specifically work for?
Shipping line [] Clearing and forwarding []
What is your current position?
Top Management [] Middle Management [] Supervising level [] Operations []
Number of years worked in the position
Below 3 years [] 3–6 years [] 7–10 years [] above 10 years []

SECTION B. ECDs Handling Equipment

Answer all questions as indicated by ticking the correct answer.

To what extent does the ECD handling equipment influence Empty Container Repositioning in Tanzania?

5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree

	ASPECTS	5	4	3	2	1
B1	ECDs loading and unloading mechanism has improved the process of empty Container repositioning in Tanzania					
B2	ECDs automated machines have adequately influenced empty container repositioning to take place efficiently and effectively					
B3	ECDs are equipped with modern equipment, which enables efficient repositioning of empty containers in Tanzania					

SECTION C: ECD Stakeholder Perspectives

Answer all questions by ticking the correct answer.

What is the influence of the ECD stakeholders' perspectives on empty container repositioning in Tanzania?

5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree

	ASPECTS	5	4	3	2	1
C1	Logistics providers facilitate accessibility and connectivity of ECDs to the port of Dar es Salaam					
C2	The existence of Importers and Exporters increased the number of empty containers repositioned via ECDs					
C3	ECD operators positively contributed to the empty containers					

SECTION D: ECD infrastructure

Answer all questions by ticking the correct answer.

How does the ECD Infrastructure contribute to Empty Container Repositioning in Tanzania?

5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree

	ASPECTS	5	4	3	2	1
D1	ECDs have transport networks that ensure efficient and speedy empty container repositioning					
D2	ECDs are adequately accommodated with storage capacity that assures timely cargo clearance					
D3	ECDs have an efficient and speedy ICT system to facilitate on-time empty container repositioning					

SECTION E: Empty Container Repositioning

Answer all questions by ticking the correct answer.

To what extent do the ECDs influence Empty Container Repositioning in Tanzania?

5 = Strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly Disagree

	ASPECTS	5	4	3	2	1
E1	The existence of ECDs influences the elimination of the unbalanced distributions of empty containers around Dar Es Salaam Port					
E2	ECDs encourage accurately tracking the movement of empty containers to avoid overstocking and unnecessary storage expenses					
E3	ECDs have led to significant time savings and improved overall efficiency of empty containers operations in Tanzania					

Appendix 2: Survey data

S/N	ECDs -Handling Equipment (Loading and Unloading)	ECDs -Handling Equipment (Automated machine)	ECDs-Modern equipment	ECD-Stakeholders Perspectives (Logistics Providers)	ECD_Stakeholders (Existence of Importers and Exporters)	ECDs operators.	ECDs-Infrastructure (Transport Networks)	ECD Stakeholders (Accommodated with storage capacity).	ECDs- Stakeholders (Efficient and speedy ICT system)	CR- ECDs elimination of the unbalancing EC)	CR- (ECDs) encourages accurately tracking EC movement)	CR- (ECDs time savings and efficiency of EC)
1	5	5	5	5	5	5	4	5	4	4	4	4
2	1	5	5	4	5	5	5	4	5	5	5	5
3	5	4	4	4	4	4	4	4	4	5	5	5
4	2	3	3	2	3	2	3	3	3	3	3	3
5	2	3	2	4	4	2	2	4	2	3	3	4
6	2	4	3	3	2	3	3	2	4	4	2	2
7	4	4		4	4	4	4	4	4	4	4	4
8	4	4	4	4	4	4	4	2	4	4	4	4
9	2	2	2	4	4	2	1	1	1	2	3	2
10	4	4	5	4	4	4	5	4	4	5	5	5
11	3	1	3	5	3	3	5	5	5	3	3	3
12	3	3	5	4	5	5	3	3	5	5	4	5
13	5	4	4	5	4	4	4	4	3	4	4	4
14	4	5	4	4	4	4	4	4	4	4	4	4
15	3	4	3	5	4	4	4	3	3	3	3	3
16	4	4	3	5	4	4	3	3	3	4	4	4
17	3	4	4	3	4	3	4	2	3	2	4	3
18	3	3	4	4	5	5	4	5	4	5	5	5
19	4	4	3	4	4	4	2	3	3	4	4	4
20	4	4	4	4	3	5	3	3	3	2	3	3
21	5	5	5	5	5	5	5	5	5	2	2	2
22	2	1	3	1	1	3	1	5	5	2	2	2
23	5	5	5	4	4	4	3	4	3	5	5	4
24	3	3	3	4	4	4	3	3	3	3	4	3
25	3	3	3	3	3	3	3	3	3	3	3	3
26	4	4	4	2	2	1	2	2	1	2	2	3
27	4	4	4	5	4	5	5	5	4	5	5	4
28	4	5	3	4	3	5	4	4	4	4	4	4
29	3	4	4	4	4	4	4	4	4	3	4	4
30	5	5	3	5	5	5	5	5	5	5	5	5

Appendix 2 (continued)

S/N	ECDs -Handling Equipment (Loading and Unloading)	ECDs -Handling Equipment (Automated machine)	ECDs-Modern equipment	ECD-Stakeholders Perspectives (Logistics Providers)	ECD_Stakeholders (Existence of Importers and Exporters)	ECDs operators.	ECDs-Infrastructure (Transport Networks)	ECD Stakeholders (Accommodated with storage capacity).	ECDs- Stakeholders (Efficient and speedy ICT system)	CR- ECDs elimination of the unbalancing EC)	CR- (ECDs) encourages accurately tracking EC movement)	CR- (ECDs time savings and efficiency of EC)
31	3	3	3	3	3	3	2	2	2	3	3	2
32	3	3	4	4	5	2	5	5	4	4	4	4
33	4	5	4	5	5	4	3	1	2	3	3	4
34	4	5	3	2	2	2	4	3	4	4	4	4
35	3	3	3	5	3	4	4	4	4	4	5	4
36	4	4	4	4	4	4	2	1	3	3	4	1
37	5	4	4	4	4	4	1	4	3	5	5	5
38	4	4	4	3	5	4	3	4	4	5	4	5
39	2	4	2	4	3	4	2	2	4	4	2	4
40	4	5	5	5	4	4	3	4	3	4	4	4
41	3	3	3	2	1	1	3	3	3	2	2	2
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77	4	4	4	4	5	5	4	4	2	4	4	4