The Influence of Port Infrastructures in Cargo Handling at Dar Es Salaam Port

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Abstract
Efficient cargo handling is crucial for port operations and consequently, for driving economic growth and development. Given that a significant portion of global and African trade flows through ports, ensuring efficiency in cargo handling is imperative to meet the evolving demands of the industry. However, research on the contribution of cargo handling in Tanzania, particularly in Dar es Salaam port, is insufficiently explored and documented. Nonetheless, existing evidence indicates a pressing need for conducting such studies. Therefore, this study was carried out to assess the influence of port infrastructures in cargo handling, to determine the influence of skilled staff in cargo handling and to find out the influence of logistic procedures in cargo handling. The study used descriptive research design while simple random sampling technique was used to select 90 members of sample size. In the same trail data were gathered through questionnaire while data were analysed using descriptive analysis and multiple regression analysis with the aid of SPSS. The study found that infrastructures play significant role in cargo handling for port performance since modern port infrastructure (e.g., deepwater berths, efficient cargo handling equipment) significantly improves the speed and efficiency of cargo handling at the port. The study concluded that port infrastructures are crucial factors in cargo handling for port performance. The study recommends that port authorities should continue investing in gate infrastructure modernization, includingadvanced technology for automated processes such as electronic documentation, tracking, and automated gate clearance.

Keywords: *Port Infrastructure, Cargo Handling, Dar Es Salaam Port*

1. Introduction

Cargo handling plays a crucial role in the performance of ports worldwide. Ports serve as vital hubs for international trade, facilitating the movement of goods between countries and continents. Efficient cargo handling is essential for maintaining the competitiveness and economic growth of nations, as it directlyimpacts trade volumes, transportation costs, and overall supply chain efficiency (Onyema *et al*., 2023). The global maritime industry heavily relies on ports to handlevarious types of cargo, including containers, bulk commodities, and liquid goods. Asglobal trade continues to expand, the demand for efficient cargo handling facilities atports is expected to increase significantly (Nguyen & Notteboom, 2022). Effective cargo handling is determined by a number of factors in port investment including hard infrastructure, soft infrastructure and human capital. The study in China indicated that China's ambitious Belt and Road Initiative (BRI) has led to massive port investments hard

infrastructures such as cargo handling, docks capacity transforming its ports into major global hubs. Ports such as Shanghai, Shenzhen, and Ningbo-Zhoushan have witnessed significant infrastructure development such as cargo handling, docks capacity, storage capacity and technological advancements so as to ensure reliability, connectivity and time (Hu, 2021). Efficient port infrastructure is essential for ensuring the smooth flow of goods, reducing transportation costs, and enhancing overall economic competitiveness. Ports serve as crucial gateways for imports and exports, connecting producers and consumers across different regions (Jeevan, 2019). However in most African developing countries, cargo handling has been hampered by lack of manageial resources, financial resources, poor infrastructures (Rodrigue, 2020). These challenges have been exacerbated in the environment of globalization, production, distribution, technological changes in ship design, and cargo handling methods, which haveinduced considerable demand on port resources (Somanga, 2021).

Dar es Salaam port is the Tanzania major port with rated capacity of 4.1 million(dwt) dry cargoes and 6.0 million (dwt) bulk liquid cargoes. The port has a totalquay length of about 2000 metres with eleven deep water berths (TPA, 2019). Dar es Salaam port has not yet increased port capacity ahead of demand. Port inefficiency causes delays with associated cost to ship operators, importers or exporters and charter parties (TPA, 2019). Hence efficient cargo handling is crucial for port operations and consequently, for driving economic growth and development. Given that a significant portion of global and African trade flows through ports, ensuring efficiency in cargo handling is imperative to meet the evolving demands of the industry. However, research on the influence of infrastructure on cargo handling in Tanzania, particularly in Dar es Salaam port, is insufficiently explored and documented. Nonetheless, existing evidence indicates a pressing need for conductingsuch studies.

2. Literature Review

Resource-based theory is a framework that explains how a firm's resources and capabilities can lead to sustained competitive advantage. The theory was first introduced by Edith Penrose in 1959 and later developed by Jay Barney in 1991. Themajor assumptions of the theory are that resources must be heterogeneous andimmobile (Kozlenkova, 2014). The theory contends that the possession of strategic resources provides an organization with a golden opportunity to generate sustained competitive advantage. The key constructs in the theory are firm resources and capabilities employed in generating competitive advantage, sustainable competitive advantage, market attractiveness, and financial performance (Armstrong, & Shimizu,2017). The strength of the theory is that it provides a theoretical foundation for evaluating innovations that can be used in practice. However, the theory has some weaknesses, such as the difficulty in identifying and measuring resources and capabilities, and the lack of guidance on how to develop resources and capabilities (Arnold *et al*, 2011).

RBT suggests that ports with superior cargo handling resources and capabilities, such as advanced equipment, skilled workforce, and efficient processes, can achieve a competitive advantage. Implementing lean management practices and continuous improvement initiatives can optimize cargo handling operations and reduce waste, leading to improved performance. According to RBT, ports with ample storage capacity and efficient storage management systems can gain a competitive edge by offering reliable and flexible services to customers.

Investing in the expansion and modernization of storage facilities, such as warehouses, silos, and tank farms, can increase the port's capacity to handle diverse cargo types and accommodate future growth. RBT emphasizes the importance of intangible resources, such as knowledge, information, and technology, in creating a sustainable competitive advantage. Investing in advanced ICT systems, such as terminal operating systems (TOS), port community systems (PCS), and electronic data interchange (EDI), can streamline information flow, enhance communication among stakeholders, and improve decision-making processes.

3. Methods

This study utilized a descriptive research design to assess the influence of infrastructure in cargo handling for port performance at Dar es Salaam Port. Descriptive research allowed researcher to collect data on existing conditions, behaviours, attitudes, or practices without intervening in any way (Cohen *et al.*, 2014). The study population for this research included TPA staff, port managers,port customers, and customer department personnel.

The sample sizes were calculated using this system with a degree of precision of 0.05 and a 95% confidence level. Therefore, a total of 90 respondents were employed in the study. This study employed simple random sampling techniques to analyze the topic under study. In that regard, the process took place by picking randomly staff working at TPA. This technique was used due to the fact that simple random sampling ensured that each member of the population has an equal chance of being included in the sample. The study used questionnaire to gather data from the respondents.

This research used descriptive analysis and multiple regression models to analyze data related to gate operations performance on cargo loading, whereby descriptive analysis provided summary of data collected related to study topic and multiple regression models showed the relationship between variables including documentation procedures, management efficiency, technological skills as well as cargo loading. On the other hand the reason behind is to establish relationship between independent variables and dependent variable. The regression model is as follows:

$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$

Where by

Y= Cargo handling

βo= Constant factor

X_1 = Cargo handling toolsX_2= Storage capacity X_3= ICT

e = Error term

The study conducted a pilot test to ensure the validity of the findings concerning theresearch problem. A pre-test was conducted with 20 respondents to determine if the questionnaires contained anything that would be difficult to interpret during data analysis. According to Kothari (2014), validity was used to measure whether the study's results truly reflect what they appear to be about and to check the connectionsbetween independent and dependent variables.

Reliability, according to Cohen (2014), is the degree to which data collection techniques produce consistent results across multiple measurements of a study variable relevant to the

research problem. As a result, Cronbach's alpha was applied to determine the reliability of the independent and dependent variables in this study. Data reliability was assessed using statistical techniques, such as Cronbach's alpha,to determine the internal consistency of the questionnaire items. Cronbach's alpha was widely used to measure the internal consistency of a scale or instrument, providing an indication of how well the items in the questionnaire correlated with each other.

Table 1 Reliability Statistics

Variables	**Cronbach's Alpha**
Cargo handling tools	0.781
Storage capacity	0.827
ICT	0.821
Cargo handling	0.920

Source: Field data, 2024

In Table 1, we see the Cronbach's Alpha values for various variables related to cargohandling equipment. These values were derived from field data collected in the year 2024.

The first variable, "Cargo handling tools," had a Cronbach's Alpha value of 0.781. This indicates that there is a reasonable level of internal consistency among the itemsor questions that make up this variable. However, it is worth noting that values above 0.9 are typically considered excellent, and values between 0.7 and 0.9 are considered acceptable.

The second variable, "Storage capacity," had a higher Cronbach's Alpha value of 0.827. This suggests that there is a stronger degree of internal consistency among theitems or questions in this variable compared to the first one.

The third variable, "ICT" (Information and Communication Technology), had a Cronbach's Alpha value of 0.821. Similar to the first variable, this value falls within the acceptable range for reliability coefficients.

The fourth and final variable, "Cargo handling," had an impressive Cronbach'sAlpha value of 0.920. This indicates an excellent level of internal consistency amongthe items or questions in this variable.

In summary, Table 1 provides us with valuable information about the reliability of various cargo handling equipment-related variables as measured by their respective Cronbach's Alpha coefficients. The data was collected through field research in the year 2024 and reveals that all variables exhibit at least an acceptable level of internal consistency, with some variables demonstrating strong levels of consistency (e.g., storage capacity and cargo handling).

4. Results and Discussion

4.1 Respondents' Characteristics

The study categorized respondents based on their gender, age group, educational level, to avoid gender bias and evaluate respondents' maturity depending on their age group and level of education. This ensures that the sample represents the population of interest accurately and allows for more accurate findings and conclusions. Categorizing the characteristics of respondents minimizes the possibility of errors or data redundancy and enhances data integrity during data collection.

The variable gender was evaluated in this research study. Gender is important as it describes the number of male or female respondents to the required research questions. This prevents gender bias and ensures that all genders are considered equal in decision-making, avoiding the notion that males have priority in decision- making. Including gender as a variable in this research ensures that both men and women are adequately represented in the study, promoting inclusivity and avoiding the exclusion of certain groups. Hence, data related to the gender of the respondents is presented in Table 2:-

Table 2: Respondents based on Gender

Gender	Frequency (f)	Percentages (%)
Male	57	63.3
Female	33	36.7
Total	**90**	**100.0**

Source: Field Data, 2024

Table 2 shows that 63.3% of respondents were male, while 36.7% were female. The findings indicate that the majority of respondents were male compared to female. This could be due to the fact that men were more attracted to jobs requiring physical labor and energy compared to women. All respondents were willing to mention the factors affecting cargo handling at port performance in Tanzania.

During data collection, data were collected and analyzed depending on their respondent's age, respondent were asked to provide their age group. The researcher focused also on evaluation of the maturity of the respondents by examining age group. Data related to age of the respondents are represented in Table 3:-

Table 3 Respondents Age Group

Age Group (Years)	Frequency (f)	Percent (%)
18 - 35	52	57.8
36 – 45	19	21.1
45+	19	21.1
Total	**90**	**100.0**

Source: Field Data, 2024

From the Table 3 shows that on the basis of age characteristics, 67% were aged between 18 and 35 years, 18 % of respondents were aged between 36 and 45 years old and 15% of respondents were above 45 years old. Therefore, this could be concluded that, both young people and adults were more engaged in the issues of cargo handling at port operations than any other age groups because they were energic, skills, knowledge and devotion. The study showed that most of the respondents were aged between 18 and 35 years showing that many respondents were port workers and drivers illustrating that youths are more encouraged to work at the port than other age groups.

In this study, data were collected and analyzed based on respondents' educational levels. Most respondents had degrees, diplomas, certificates, and a few of them had master's degrees. By considering the educational level, the researcher was able to collect information based on different levels of understanding and knowledge, as respondents might have different views and understandings. The data related to the level of education of respondents were recorded and presented in Table 4:

Table 4 Level of Education of Respondents

Education Level	Frequency (f)	Percent (%)
Postgraduate	20	22.2
Bachelor Degree	58	64.4
Diploma	7	7.8
Certificate	5	5.6
Total	**90**	**100.0**

Source: Field Data, 2024

The Table in 4shows that 22.2% of respondents had a postgraduate, 64.4% had a bachelor's degree, 7.8% had a diploma, and 5.6% had certificates. The study involved respondents with various levels of knowledge and understanding to extract strong data or information based on their views and opinions on the factors affecting cargo handling performance at ports in Tanzania, and to come up with criticalsolutions. The differences in respondents' levels of education also lead to differencesin views and opinions. Through considering these factors, the researcher succeededin extracting data with no errors, ensuring completeness, clarity, and consistency. This helped the researcher to document the study with minimal errors, as the data obtained were analyzed using development envelopment analysis to check for data redundancy and ensure consistency during the documentation of the study.

4.2 The Influence of Port Infrastructures in Cargo Handling

The first objective of the study sought to examine the influence of port infrastructures in cargo handling. The first objective was answered by 90 respondents while data were gathered through questionnaire.

Respondents were asked to state their level of agreement whether modern portinfrastructure (e.g., deepwater berths, efficient cargo handling equipment) significantly improves the speed and efficiency of cargo handling at the port. In that regard, the study findings are given in Figure 1:-

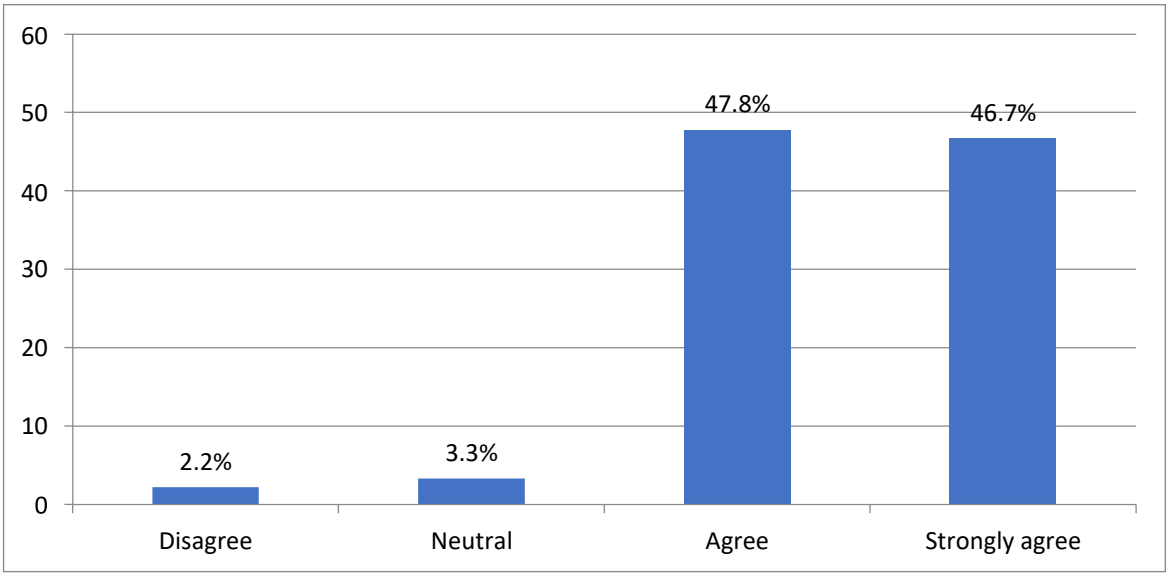

Figure 4.1 Modern Port InfrastructuresSource: Field Data, 2024

The study revealed that 2.2% disagreed that modern port infrastructure (e.g., deepwater berths, efficient cargo handling equipment) significantly improves the speed and efficiency of cargo handling at the port, 3.3% were neutral while 47.8% agreed and the rest with 46.7% strongly agreed at large. To sum up majority of respondents agreed that modern port infrastructure (e.g., deepwater berths, efficient cargo handling equipment) significantly improves the speed and efficiency of cargo handling at the port. Findings suggest that modern port infrastructure allows for larger vessels to dock and unload cargo, increasing the overall capacity of the port. This enables more goods to be handled efficiently, reducing congestion and delays.

Advanced technologies such as automated cranes, RFID tracking systems, and digital documentation processes streamline cargo handling operations. These technologies help in faster loading and unloading of goods, as well as real-time tracking of shipments. Modern port infrastructure often includes state-of-the-art security systems such as surveillance cameras, access control systems, and cybersecurity measures. This ensures the safety and security of goods being handled at the port, reducing the risk of theft or damage.

On the other hand modern ports are equipped with efficient logistics systems that optimize the movement of goods within the port premises. This includes well-planned layouts, designated storage areas, and integrated transportation networks for seamless cargo flow. Many modern

ports prioritize environmental sustainability by implementing eco-friendly practices such as shore power facilities for vessels, waste management systems, and energy-efficient operations. This not only reduces the carbon footprint of port activities but also enhances the overall reputation of the port authority. The study findings are supported by Talley (2017) that modern ports are equipped with state-of-the-art machinery such as container cranes, straddle carriers, and automated guided vehicles (AGVs). These machines can handle cargo more quickly and efficiently than manual methods, reducing loading and unloading times. Automation plays a crucial role in modern port operations. Automated systems for container tracking, inventory management, and cargo handling streamline processes, minimize errors, and optimize resource utilization, ultimately enhancing overall efficiency. Many modern ports have deeper water channels and larger berths, allowing larger vessels to dock directly at the port. This reduces the need for transshipment and speeds up the loading and unloading process. Modern ports are often integrated with efficient rail and road networks, enabling seamless transportation of cargo to and from the port. This integration reduces transit times and congestion, enhancing overall efficiency.

Respondents were asked to state their level of agreement whether adequate storage facilities within the port are crucial for smooth cargo handling and flow. In that regard, the study findings are given in Figure 2:-

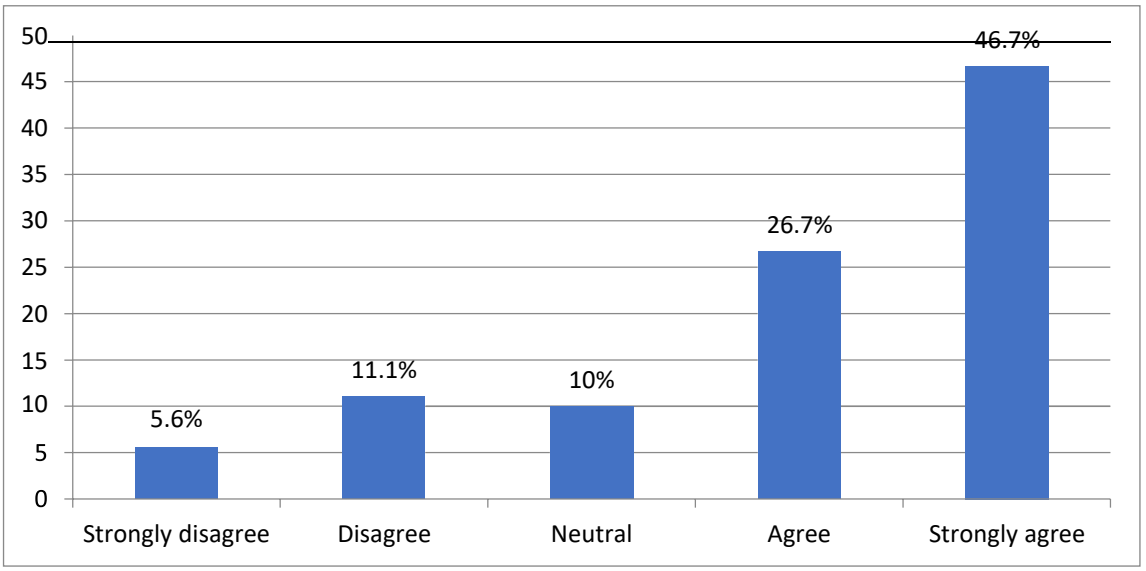

Figure 2 Adequate Storage FacilitiesSource: Field Data, 2024

The study revealed that 5.6% disagreed that adequate storage facilities within the port are crucial for smooth cargo handling and flow, 11.1% disagreed, 10% were neutral while 26.7% agreed and the rest with 46.7% strongly agreed at large. To sum up majority of respondents strongly agreed that adequate storage facilities within the port are crucial for smooth cargo handling and flow. Findings suggest that adequate storage facilities within the port are crucial for smooth cargo handling and flow at the Tanzania Port Authority for several reasons. Firstly, having sufficient storage space ensures that incoming cargo can be promptly offloaded from vessels and stored securely until it is ready for onward transportation. This helps prevent congestion at the port and minimizes delays in cargo processing, ultimately improving overall

efficiency.

Secondly, proper storage facilities enable effective organization and categorization of different types of cargo, making it easier to locate specific shipments when needed. This streamlines the retrieval process and reduces the risk of errors or mix- ups during handling. Additionally, adequate storage capacity allows for strategic planning in terms of inventory management, enabling port authorities to optimize space utilization and minimize wastage. Furthermore, having well-maintained storage facilities contributes to the safety and security of goods in transit, protecting them from damage, theft, or spoilage. Finally, efficient storage operations helpenhance the reputation of the port as a reliable hub for international trade, attracting more shipping companies and fostering economic growth.

The study findings are supported by Hoyle (2019) that ports serve as key points of transit for goods, and efficient storage facilities enable effective inventorymanagement. Goods can be stored temporarily while awaiting transfer to onward transportation modes or until they are ready for distribution. Ports often function as transshipment hubs where cargo is transferred from one mode of transport to another(e.g., ship to truck or vice versa). Adequate storage facilities are essential for temporarily housing goods during this transition, ensuring a seamless transfer process. Ports can experience congestion due to various factors such as weather conditions, labor strikes, or sudden increases in cargo volume. Having sufficient storage capacity allows ports to handle surges in cargo flow without causing bottlenecks or delays in operations.

Respondents were asked to state their level of agreement whether modern ICTsystems within the port (e.g., cargo tracking, real-time data exchange) facilitate faster cargo processing and clearance. In that regard, the study findings are given in Figure.3:-

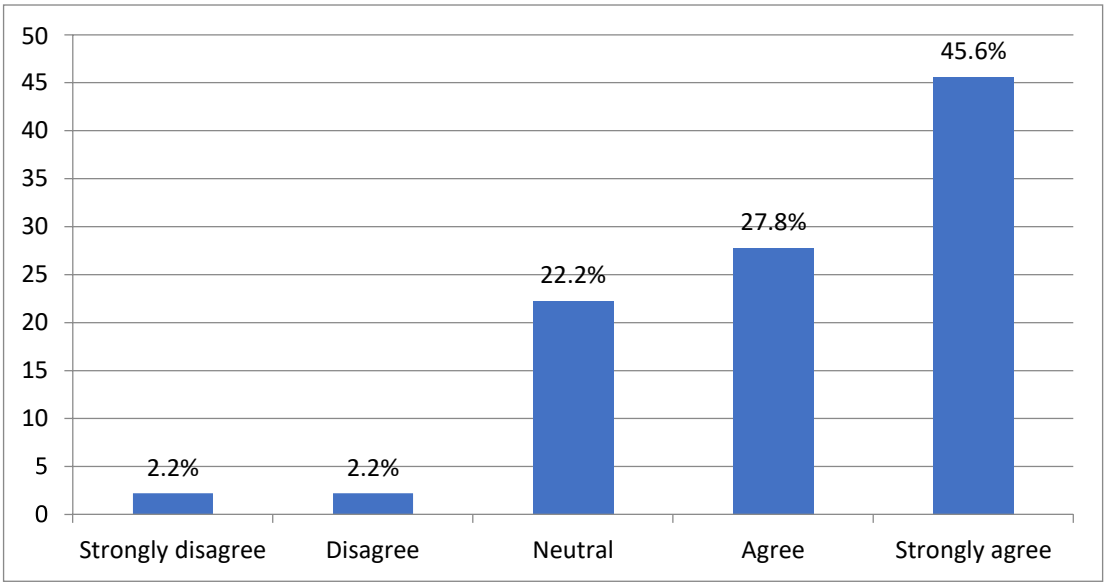

Figure 3 Modern ICT SystemsSource: Field Data, 2024

The study revealed that 2.2% disagreed that modern ICT systems within the port (e.g., cargo tracking, real-time data exchange) facilitate faster cargo processing and clearance, 2.2% disagreed, 22.2% were neutral while 27.8% agreed and the rest with 45.6% strongly agreed at large. To sum up majority of respondents strongly agreed that modern ICT systems within the port (e.g., cargo tracking, real-time data exchange) facilitate faster cargo processing and clearance. Findings suggest that

modern Information and Communication Technology (ICT) systems play a crucial role in facilitating faster cargo processing and clearance at the Tanzania Port Authority. These systems, such as cargo tracking and real-time data exchange, have revolutionized the way ports operate by streamlining processes, improving efficiency, and enhancing overall productivity. The implementation of modern ICT systems within the port environment has brought about several key benefits that contribute to expedited cargo processing and clearance.

Firstly, modern ICT systems enable real-time tracking of cargo throughout its journey within the port. This allows for better visibility and monitoring of cargo movements, leading to improved operational planning and resource allocation. Through having access to accurate and up-to-date information on the location and status of each shipment, port authorities can make informed decisions quickly, thereby reducing delays in processing and clearance procedures. Secondly, the automation of data exchange processes through ICT systems eliminates manual paperwork and reduces the likelihood of errors or discrepancies in documentation. Electronic data interchange enables seamless communication between various stakeholders involved in the cargo handling process, including shipping companies, customs officials, freight forwarders, and port operators. This streamlined flow of information accelerates decision-making processes and expedites cargo clearance by minimizing bureaucratic hurdles.

Moreover, modern ICT systems facilitate collaboration and coordination among different entities within the port ecosystem. Through providing a centralized platform for sharing information and coordinating activities, these systems promote transparency, accountability, and efficiency in cargo handling operations. Enhanced communication channels enable stakeholders to work together seamlessly towards common goals, resulting in faster turnaround times for cargo processing and clearance. Furthermore, ICT systems support risk management strategies by enablingreal-time monitoring of security threats and compliance issues. Through advanced technologies such as RFID tagging, GPS tracking, and electronic seals, ports can enhance security measures and ensure regulatory compliance throughout the supply chain. Through proactively identifying potential risks and taking preventive measures promptly, port authorities can expedite cargo processing while maintaining high standards of safety and security.

The study findings are supported by Mapunda (2016) ICT systems automate various processes involved in cargo handling, reducing manual intervention and streamlining operations. Automated systems can handle tasks such as data entry, documentation processing, and cargo tracking more efficiently than manual methods. ICT systems enable real-time communication and data exchange between different stakeholders involved in the port ecosystem, including shipping lines, customs authorities, freight forwarders, and port operators. This real-time exchange of information allows for faster decision-making and coordination, leading to quicker cargo processing. Modern ICT systems digitize documentation processes, replacing paper-based systems with electronic formats. This eliminates the need for physical paperwork, reducing processing times associated with document handling, verification, and approval.

4.3 Multiple Linear RegressionModel Summary

Table 5 presents the Model Summary for a regression analysis. In this table, several statistics are provided to evaluate the performance of the model in predicting the dependent variable based on the independent variables included in the analysis.

Table 5 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.964[a]	.930	.928	.233

a. Predictors: (Constant), Cargo handling tools, Storage capacity, ICT

In this case, R Square is 0.930, indicating that approximately 93% of the variance in the dependent variable can be explained by the independent variables. The Adjusted R Square here is 0.928. The predictors included in this model are “Cargo Handling Tools,” “Storage Capacity,” and “ICT.” These variables are used to predict or explain variations in another variable, typically referred to as the dependent variable.

Analysis of Variance (ANOVA)

In the provided information, Table 6 presents the results of an Analysis ofVariance (ANOVA) for a regression model with the dependent variable being Cargo Handling. The table displays the sum of squares, degrees of freedom, mean square, F-value, and significance level for both the regression model and the residual errors.

Table 6 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	62.469	3	20.823	382.146	.000[b]
	Residual	4.686	86	.054		
	Total	67.156	89			

a. Dependent Variable: Cargo Handling
b. Predictors: (Constant), Cargo handling tools, Storage capacity, ICT

In this table, the model's sum of squares is 62.469 with 89 degrees of freedom, resulting in a mean square of 20.823. The F-value is calculated as 382.146 with a significant p-value of .000. This indicates that the regression model as a whole is statistically significant in explaining the variation in Cargo Handling. The residual sum of squares is 4.686 with 86 degrees of freedom, leading to a mean square of
0.054. The total sum of squares is 67.156 with 89 degrees of freedom. The predictorsin this model include a constant term along with three independent variables: Cargo Handling Tools, Storage capacity, ICT. Overall, the ANOVA table provides insights into how well the regression model fits the data and whether the included predictors have a significant impact on Cargo Handling.

CoefficientTable 7 Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.079	.136		-.584	.561		
	Cargo handling tools	.261	.100	.256	2.617	.010	.085	11.791
	Storage capacity	.270	.074	.259	3.653	.000	.162	6.174
	ICT	.498	.074	.487	6.744	.000	.156	6.417

a. Dependent Variable: Cargo Handling

Table 7 presents the coefficients of a regression model with the dependent variable being Cargo Handling. The table includes unstandardized coefficients, standardized coefficients, t-values, significance levels (Sig.), and collinearity statistics.

1. **Cargo handling tools**: The coefficient for cargo handling tools is 0.261 with a standard error of 0.100 and a standardized coefficient (Beta) of 0.256. Thet-value is 2.617, indicating that this variable is statistically significant at the
0.01 level (p = 0.010). The tolerance value is 0.085, suggesting lowmulticollinearity with a variance inflation factor (VIF) of 11.791.
2. **Storage capacity**: The coefficient for storage capacity is 0.270 with a standard error of 0.074 and a standardized coefficient of 0.259. The t-value is3.653, indicating that this variable is statistically significant at the 0.001 level(p = 0.000). The tolerance value is 0.162, with a VIF of 6.174.
3. **ICT**: The coefficient for ICT is 0.498 with a standard error of 0.074 and a standardized coefficient of 0.487. The t-value is 6.744, indicating that thisvariable is statistically significant at the 0.001 level (p = 0.000). Thetolerance value is 0.156, with a VIF of 6.417.

5.0 Conclusion and Recommendations

5.1 Conclusion

On the basis of study objective which was to examine the influence of port infrastructures in cargo handling, the study concludes that port infrastructures play significant role in cargo handling for port performance since modern port infrastructure (e.g., deepwater berths, efficient cargo handling equipment) significantly improves the speed and efficiency of cargo handling at the port.

5.2 Recommendations

The study recommends that port authorities should continue investing in gate infrastructure modernization, including advanced technology for automated processes such as electronic documentation, tracking, and automated gate clearance.

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