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An Assessment of Technical Efficiency of Customs Clearance Agencies (CCAS) Offering Cargo Clearance Services at Dar Es Salaam Port

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CERTIFICATION

The undersigned certifies that she has read and recommends for acceptance by the Dar es Salaam Maritime Institute (DMI) a dissertation entitled **"AN ASSESSMENT OF TECHNICAL EFFICIENCY OF CUSTOMS CLEARANCE AGENCIES (CCAS) OFFERING CARGO CLEARANCE SERVICES AT DAR ES SALAAM PORT**" submitted as partial fulfillment of the criteria for a Masterdegree in Shipping Economics and Logistics (MSEL) at (DMI)

.....
Dr Tumaini Gurumo
Supervisor

…….....……
Date

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DECLARATIONANDCOPYRIGHT

I, **Andulile Raphael Mwaisaka,** hereby declare that this dissertation is my own original work, that it has not been presented to any other higher learning institution for a similar or other degree award, and that it will not be presented to any other higher learning institution for a similar or other degree awards.

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DEDICATION

My wife Helena Alphonce Temba and her lovely daughter Diana Andulile Mwaisaka, as well as her loving brothers Davis Andulile Mwaisaka, Dominick Andulile Mwaisaka, Damas Andulile Mwaisaka, and Danny Andulile Mwaisaka, are the subjects of my dissertation. All of them, through their spiritual presence, played a critical role in the project's overall success. Their encouraging words and firm hug, which was accompanied by love as I arrived home late, helped greatly to the conducive and supporting environment for this achievement, both psychologically and emotionally.

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LIST OF ACRONYMS

BCC	Bankers, Charnes and Cooper
CCAs	Customs Clearance Agencies
CCR	Charnes, Cooper and Rhodes
CRS	Constant Returns to Scale
CRSTE	Constant Return to Scale Technical Efficiency
DEA	Data Envelopment Analysis
DMUs	Units that Make Decisions
DRS	Decreasing Returns to Scale
ICT	Information, Communication and Technology
IRS	Increasing Return to Scale
ITE	Input Technical Efficiency
MSEL	Masters of Shipping Economics and Logistics
OTE	Output Technical Efficiency
RTS	Returns to Scale
SFA	Stochastic Frontier Analysis
SE	Scale Efficiency
STU	State Transport Undertakings
TASAC	Tanzania Shipping Agency Corporation
TE	Technical Efficiency
TEBCC	Pure Technical Efficiency
TECCR	Overall Technical Efficiency
TEI	Technical Efficiency Index
UNCTAD	United Nations Conference on Trade and Development
VRS	Variable Returns to Scale
VRSTE	Variable Return to Scale Technical Efficiency
WB	World Bank

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ABSTRACT

Logistics operations have an impact on the expenses of international trade and, as a result, the recovery of national economies. Efficient and effective management of logistics performance makes countries more competitive internationally. The goal of this research was to evaluate the technical efficiency of CCAs that provide cargo clearance services at Dar es Salaam Port, with a focus on the impact of office space (in square meters), staff qualifications, and ICT equipment on technical efficiency.

During the selection of CCAs for inclusion in the study, the researcher used systematic sampling approaches. Questionnaires and interviews were used to collect data, which was then analyzed using the Data Envelopment Analysis Programme (DEAP/DEA) version 2.1. DEA uses linear programming analytical approaches to identify the best input resource solution for the best service output.

Only 9 CCAs out of 63 tested and examined were technically efficient under CRS, accounting for 14% of the total sample, while 54 CCAs out of 63 sampled CCAs, accounting for 86% of the total sample, were technically inefficient. The research findings, on the other hand, indicated that 12 CCAs, or 19% of the sampled CCAs, were technically efficient under VRS, whereas 42 CCAs, or 67% of the 63 studied CCAs, were neither technically efficient under CRS nor technically efficient under VRS.

Furthermore, 51% of the 63 CCAs,63% of the 63 CCAs and 62% of the 63 CCAs technical efficiency were attributed to Office space (in square meters), some staff with professional training in(logistics/shipping) and computers equipment consecutively.

It is recommended that further and detailed studies are necessary to be conducted in the same area where a sample size and time will be increased. Other studies can be conducted to assess the trend of CCAs technical efficiency for the period of time. Despite of these, studies can be conducted to asses CCAs allocative efficiency and the optimal resource requirement for optimal service provision.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter provides a summary of the study's history, problem statement, and general and specific study objectives. It further gives highlights of research questions, research significance and its scope.

1.2 Background of the Study

It has been documented that "Maritime transport was the backbone of the world economy as more than 90% of world trade was carried by sea (Grote, 2016; United Nations Business Action Hub, 2019 as cited in Rahman, 2019).

UNCTAD (2014)argued that approximately 9.5 billion tons of goods was loaded for seaborne transport in ports worldwide, and it continued to increase in 2015 where approximately 9.8 billion tons of goods were transported via seaborne trade annually.

Approximately 90% of Tanzania's international trade transits through the Dar es Salaam port. In view of the above, an efficient customs Clearance processes and quality and competent logistical services was of paramount (World Bank, 2013).

Customs Clearance procedure was crucial for easy doing business environment, it influenced other port operations and many port operations were strongly influenced by customs. Tanzania was one of the countries in the East with the biggest delays of customs clearance among East and South African countries, Ethiopia (30 days), Kenya, Tanzania and Uganda (14 days each) were the countries with bigger delays in Clearance customs; while Cameroon (20 days), Nigeria (18 days) and Malawi (17 days) were the West African countries with the biggest delays" (World Bank, 2002).

The port of Dar es Salaam was appreciably less effective than the Mombasa port. One of the reasons for being less green was immoderate live time on the port of Dar es Sa-laam due to slug wash processing, especially the processing of customs clearances, and excessively long storage intervals (World Bank, 2013).

The average rating of the logistics performance index for Tanzania indicates that from 2007 to 2016 ranged between 2.08 to 2.99 respectively. The key areas considered in the logistics performance index were Customs, infrastructure, international shipments, logistics quality and competence, tracking and tracing, and timeliness Arvis et al., (2018).

The Logistics performance index for Tanzania under component of customs scores ranged from 2.07 to 2.78 in the year 2007 to 2016 respectively. The component of competence and quality of logistics services scores ranged from 1.92 to 2.92 in the year 2007 to 2016 respectively Arvis et al., (2018).

The underperformance of logistics performance indicator components specifically in competence and quality of logistics services was probably attributed to the inefficiency of Customs Clearance Agencies (CCAs).The researcher aimed at assessing the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port, which contribute to the overall efficiency of logistics performance indicators specifically under the component of competence and quality logistics services in the logistics performance index.

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1.3 Statement of the Problem

The Logistics performance index for Tanzania since the year 2007 to 2016 had never rated as best performers. Since then, its performance ranking ranged from 2.08 to 2.99 respectively which was not satisfactory competitive enough to create a more conducive business environment. The performance rating was partly attributed by the inefficiency of the six criteria used to calculate logistics performance indicators. The logistics performance index was made up of six components: customs, infrastructure, ease of scheduling shipments, quality of logistics services, punctuality, and tracking and monitoring (Arvis et al., 2018).

Tanzania did not fare well in all of the components, particularly under competence and quality logistics services component- primarily in trucking, forwarding and customs brokerage. The rating under the component was 1.92 to 2.92 from the year 2007 to 2016.The performance rating was neither poor nor high. Poor logistic performance indicator has a direct negative impact on export and import. Exports have a significant impact on economic growth because they improve the state's balance of payments by eliminating deficits and improving the value of the local currency and import of services as a percentage of gross domestic product. The inefficient performance of competence and quality logistics services component- primarily in trucking, forwarding and customs brokerage called for an assessment of technical efficiency of customs Clearance agencies (CCAs) offering cargo Clearance services at Dar es Salaam Port.

However, there was little documentation available on the technical efficiency of CCAs in Tanzania. The researcher aimed at filling the knowledge gap in this area so that to contribute to the body knowledge relating the assessment of technical efficiencies of various Organization on service provision at Dar es Salaam Port.

As a result, the study looked at how input resources were used by customs Clearance agencies during the customs Clearance process to achieve the optimal service output in the process of cargo clearance. Furthermore, the study assessed how each of the available resource input contributed to the overall technical efficiency of the CCAs offering cargo Clearance services through Dar es Salaam Port.

1.4 Study Objectives

1.4.1 The Overall Objective

The general objective of the study was to assess the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port.

1.4.2 Specific Objectives

The study was guided by the following specific objectives

(i) To examine the effects of Office Space (in sq. meters) on the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port.
(ii) To examine the role of Staff qualifications on the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port.
(iii) To assess the effects of ICT equipment on the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port.

1.4.3 Research Questions

The following were the study's research questions:

(i) How does office space (in square meters) affect the technical efficiency of CCAs that provide cargo Clearance services at Dar es Salaam Port?
(ii) What were the effects of Staff qualifications on the technical efficiency of CCAs offering cargo clearance services at Dar es Salaam Port?
(iii) What were the effects of ICT equipment on the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port?

1.5 Significance of the Study

The importance of this research lies in its contribution to a better understanding of the input resources required by CCAs in providing effective cargo Clearance services at Dar es Salaam Port. The specific contributions were to increase the technical efficiency of CCAs that provide cargo Clearance services at Dar es Salaam Port. CCAs technical efficiency was of paramount importance in trade logistics and the overall international trade facilitation efforts.

Second, the study sought to identify CCA input resources that make a significant contribution to their technical efficiency in providing cargo Clearance services in Tanzania via port services.

Third, evaluation of CCAs that were technically capable of providing cargo Clearance services at Dar es Salaam Port provides the ground of increasing productivity in service production through effective optimal use of input resources.

Fourth, the findings of the study might be used to evaluate CCAs' technical efficiency in providing cargo Clearance services at Dar es Salaam Port, because technical efficiency shows how well CCAs were performing in terms of getting the most out of the available input resources.

Furthermore, the goal of this study was to spark policy debate about how to manage and improve CCA's operations in providing cargo Clearance services through port services at Dar es Salaam Port. The ultimate

Furthermore, this research intended to ignite policy debate on how to manage and improve CCAs operations in offering cargo Clearance services at port services.

1.6 Research Scope

The purpose of the study was to assess the technical efficiency of CCAs at Dar es Salaam Port that provide cargo Clearance services specifically at Dar es Salaam Port. In order to accomplish this, the researcher selected sixty-three (63) CCAs from a total of 800 registered CCAs and assessed them on their technical efficiency concerning the independent service provision factors. CCAs registered with Tanzania Shipping Agencies Corporation (TASAC) as cargo Clearance service providers at Dar es Salaam Port were used to create the sample.

The sampled CCAs were consulted through email to fill in the questionnaire which was designed to obtain a response to the determined variables. The questionnaire contained all dependent and independent variables necessary to accomplish the study. The independent variables were office Space in square meters, number of staff the CCA employed, the number of staff with professional training in (logistics/shipping), number of computers owned by the CCA, and number of computer equipment networked with the cargo Clearance systems (TANCIS, cargo systems etc.,).

The dependent variable was the volume of cargo in tons cleared by CCAs as a result of the available inputs resources which in this case were treated as independent variables.

1.7 Research Limitations

The research was limited to customs Clearance agencies (CCAs)at Dar es Salaam Port with a study sample of sixty-three (63) drawn from the TASAC register as service providers. This called for an assessment of only one part which constituted in the competence and quality logistics services, including trucking, forwarding, and customs brokerage one of the component in the logistical performance indicators.

Also, the study was limited to assessing the technical efficiency of the CCAs and not the allocative efficiency of CCAs. The assessment of both technical and allocative efficiency could give research results

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of CCA efficiency in totality and not only technical efficiency. The research was an ITE (input-oriented technical efficiency), not an OTE. Data collection was only limited to one year collected from self-declared CCAs company responses. This was due to time constraints available to construct a large sample of data set for collection, arrangement, editing, analysis and interpretations which could require a much longer time to finish the study.

Furthermore, the study was nonparametric applying DEA and not stochastic, this excluded it from assessing the statistical significance of the findings from the studied sample.

1.8 Summary

This chapter covered the chapters introductory, as well as the background and problem statement. The study objectives, research questions, research questions, research significance, contribution to the body of knowledge are also covered in this section. Finally, it discusses the research scope, limits, and procedures that was used to complete this research.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The theoretical and empirical concepts of measuring a firm's economic efficiency were explained in this section; the chapter begins with definitions of key words, approaches, as well as the aspects to think about when assessing technical efficiency performances of any firm in the chosen area of study. In general, the study aims to concentrate on and highlight the most essential concerns and/or features of assessing the technical effectiveness of Tanzanian CCAs. As a result, the study seeks to highlight the significance and interaction between concepts and practice in this section. The definitions and details on measuring the technical efficiency of CCAs were discussed.

2.2 Theoretical Literature Review

Technical and allocative components make up economic efficiency. The technical component refers to the ability to avoid waste by creating as much output as technology and input consumption will allow or by using as little input as technology and output production will demand. As a result, technical efficiency analysis might take either an output-enhancing or an input-conserving approach Weible et al., (2008).

The output-to-input ratio was referred to as efficiency. It denotes the cost of resources used to complete an activity with specified outputs. The term "technical efficiency" refers to the broad definition of efficiency, which was defined as the ratio of inputs to outputs Tigga et al., (2015). In addition, in economic discourse, he described economic efficiency in three ways. First, technical or productive efficiency refers to the most technologically efficient utilization of resources. Technically efficient production, or getting the most potential output (s) from a given set of inputs, was originally defined with precision by Farrell and approximates what laypeople generally perceive as "best practice" in production.

The employment of frontier functions has been intricately tied to the measuring of economic efficiency. In all domains, modern literature begins with the same important paper, Farrell's (1957). Farrell devised a way to breakdown the overall efficiency of a production unit into its technical and allocative components, influenced by Koopmans (1951)'s formal definition and Debreu (1951)'s measure of technical efficiency.

Farrell distinguished the several ways in which a productive unit can be inefficient, including generating less than the maximum output possible from a set of inputs (technically inefficient) or failing to purchase the optimal bundle of inputs given their prices and marginal productivities (allocative inefficient) Murillo-Zamorano (2004),

If a rise in any output necessitates a reduction in at least one input, and if a reduction in any input necessitates an increase in at least one other input or a reduction in at least one input, the producer was technically efficient. As a result, a technically inefficient producer might either generate the same outputs with less input or use the same inputs to produce more outputs, Fried et al., (2008). The researcher assessed how much of the input resources deployed by the CCAs could call for optimal service production in cargo Clearance at Dar es Salaam Port.

The extent to which resources were allocated to the user with the highest predicted value was known as allocating efficiency. A company was technically efficient if it can create a set of outputs with the fewest feasible inputs. Technical efficiency, on the other hand, was the firm's ability to optimize outputs from a given set of inputs and was linked to managerial decisions, as proposed by Abel et al., (2016). Furthermore, constant returns to scale, increasing returns to scale, and decreasing returns to scale were the three options available to businesses. When the relationship between input and output was constant, a constant returns scale was achieved. In this scenario, the output changes proportionally to changes in inputs, indicating that

the organization was scale-effective. If an organization's output grows faster than its inputs, it is said to be experiencing growing returns to scale.

If an organization's output grows faster than its inputs, it was said to be experiencing increasing returns to scale. This indicates that the organization was undersized and hence has room to grow. When the rise in output was much smaller than the increase in inputs, decreasing returns to scale occurs.

This means that the organization was overly large above the optimal size. Both the phenomena of increasing returns to scale and decreasing returns to scale show that the organization was operating outside the optimal scale hence exhibiting scale inefficiency. The various forms in which efficiency has been studied shows that the concept of efficiency was a multi-faceted concept with several meanings depending from which perspective it was regarded

Both production efficiency and TE were indicators of a farm's ability to generate maximum output from a given set of inputs; TE refers to the physical relationship between the inputs used in the production process. The output-to-input ratio, or TE, was an assessment that compares the output to input. Farms that were efficient products on the production frontier, or on the efficient isoquant, to put it another way. The sum of weighted outputs divided by the sum of weighted inputs can be used to calculate TE MDH eidari et al., (2011).

Furthermore, economic efficiency can be assessed in terms of either output or input, an input-oriented measures of efficiency were relevant measures of managerial performance in situations where managers have placed nonnegative values on inputs (again, not necessarily market values) and outputs have been predetermined. If, for example, the input mix of the firm has been predetermined, then the most relevant measure was input-oriented technical efficiency (ITE) (O'Donnell 2018).

To summarize the above theoretical review, it was concluded that technical efficiency of any Organization was the ratio of its output in goods or services to the inputs used to produce such goods and services. This means that any Organization can be assessed on its technical efficiency based on the dominant sector where it operates. This research was looking at the technical efficiency of CCAs which provide cargo Clearance services at port services. The input resources to this study were Office space in square meters, number of staff employed by the CCA, number of staff with professional training in (logistics/Shipping), number of computer owned by the CCA and number of a computer equipment networked with cargo Clearance systems (TANCIS, Cargo systems etc,). These were treated as independent variables. The expected output was the volume of cargo volume cleared in tons, this was treated as the dependent variable.

2.3 Empirical Literature Review

2.3.1 Empirical Literature Review on Measuring Technical Efficiency Worldwide

The evaluation of efficiency using parametric and non-parametric frontier methodologies has been studied in a number of publications. These strategies have been used in a variety of sectors, including economics and others. Moreover, many studies have been done to determine the technological efficiency of a variety of industries, including agriculture, banking, transportation, education, and the marine industry. The non-parametric frontier approach of Data Envelopment Analysis DEA was used in the majority of these investigations. To divide technical efficiency into pure technical efficiency and scale efficiency, DEA was performed. According to studies, scale inefficiency or pure technical inefficiency could be the main source of technical inefficiency. There was no consistency in the studies.

DEA was used to analyze the trends in technical and allocative efficiency to Texas public school districts. The results from that study indicated that there was the existence of statistically significant allocative inefficiencies. While technical inefficiency increased over the six-year sample period, allocative inefficiency remained relatively stable during this period, Banker et al., (2003). This study was specifically for the

assessment of technical efficiency and not the allocative efficiency of CCAs offering cargo Clearance services at port services. This study was applied the same methodology to assess the technical efficiency of CCAs as it was applied by Banker et al. in the Texas Public School districts.

A DEA program for assessing university department efficiency. The findings reveal that the units were inefficient on both a large scale and in terms of local pure technical efficiency. It was suggested that the Units improve their input and output factors that were under the decision maker's control Gökşenet al., (2015).

A Comparison of Non-parametric and Parametric Techniques for Measuring Technical Efficiency and Productivity Change in the Nigerian Banking Sector The findings revealed that as bank production changes to non-interest or fee-based income, mean technical efficiency under SFA and total factor productivity change in DEA both decrease Osuagwu et al., (2018).

A study concentrating on the decomposition of Technical Efficiency in the Financial System: Pure Technical and Scale Efficiency. The study found that Zimbabwe's commercial banks were technically inefficient, with an efficiency score of 82.9%. 96.6% for pure technological efficiency and 85.6% for scale efficiency respectively Sanderson et al., (2017).The findings suggest that the technical inefficiency of Zimbabwean commercial banks was mostly due to scale inefficiency caused by declining returns to scale. The conclusion was that commercial banks in Zimbabwe were functioning at a lower capacity than they should be, and hence have room to expand their operations in order to improve technical efficiency, Sanderson et al., (2018).

The efficiency of wastewater services was measured through DEA. The Danish wastewater segment was characterized by scope and density economies, according to research findings: utility providers that serve more than 100 persons per kilometer of sewerage mains and contextually supply water and wastewater services attain the highest level of efficiency. Even when purely technical efficiency diminishes as firm sizes expand, scale has been demonstrated to have no impact on worldwide efficiency Guerrini et al., (2015).

A DEA approach was used to assess the efficiency of urban and rural municipal water service bodies in South Africa. These systems have had some success, but the efficiency with which they offer water services has yet to be determined Brettenny et al., (2016).

Through the application of DEA, the efficiency of Commercial Greenhouse Strawberry was assessed. Based on the number of major inputs: human labor (h/ha), fertilizers (kg/ha), capital ($/ha), and other expenses ($/ha), as well as strawberry gross return ($/ha) as an output.

With a potential savings of 27 % of total resources, the average technical efficiency was 0.73, showing that there was plenty of room in manufacturing for more efficient and sustainable input consumption. The majority of scale-inefficient greenhouses were seeing rising returns to scale; efficiency analysis theory suggests that they were clearly small greenhouses that need to expand to save money Banaeian et al., (2011).

In order to assess technical efficiency in chicken farms, nonparametric analysis was performed Heidari et al., (2011). According to the findings of the study, farmers' average technical and scale efficiencies were 0.92 and 0.93, respectively. Farmers can save around 10% of their entire input resources if they stick to the input package, according to the data Heidari et al., (2011).

The study to examine technical efficiency of Poultry Egg Production in Ogun State using DEA revealed that Majority of the farmers were relatively technically efficient in their use of resources, with the mean technical efficient being 0.873. Farmers with large farm size were most technically efficient with a

mean of 0.8877 followed by medium farm size with a mean of 0.8687 while small farm size has the least mean of 0.8638. The mean input slack for stock, labour and feed were 3.032, 8.942, 0.482 respectively, while the output slack is zero. Years of experience and education have positive effect on technically efficiency at 1% while household size negatively affects efficiency at 1% Yusuf et al., (2007).

The technical efficiency of the Indian health-care system was assessed using DEA. According to the study's findings, only six of the 27 states were technically efficient, with an efficiency score of 1.00 Tigga et al., (2015). The remaining states were technically inefficient requiring more inputs than necessary to achieve current output levels Tigga et al., (2015).

Using DEA, a study was conducted to look at the factors that influence the technical efficiency of wheat farms in Pakistan (DEA). According to the findings of the study, the average level of total technical inefficiency was estimated to be 12%, implying that farmers' technical efficiency can be raised by 12% demonstrating that by adopting the best farm practices of the efficient farms in the sample, farmers' technical efficiency can be boosted by 12%Mirza et al., (2015).Medium farmers appeared to be more inefficient than small and big farms, owing to their lower fertilizer spending Mirza et al., (2015)

The DEA Approach was used to conduct an efficiency analysis of off-season Capsicum/Bell Pepper production in Punjab, Pakistan. According to the findings, mean technical efficiency was higher 78.8%, followed by allocative 56.6% and economic efficiencies 44.3% Ali, (2018).Technically and allocatively efficient farmers might save 21.2% on inputs and 43.4% on total costs while maintaining the same output and technology according to the study. Technical 40.8%, allocative 17.2%, and economic17.2% efficiencies were all calculated at their lowest levels as well. Small farmers are very efficient in terms of technical 89.0%, allocative 70.2%, and economic 62.5% Ali, (2018).

The technical efficiency and determinants of efficiency of rice (Oryza sativa) farms in Marmara region, Turkey. The data for this study came from a direct interview survey of 70 randomly chosen rice farm households conducted during the 2007 harvest season. According to the findings, the average technical efficiency score of sample rice fields was 0.92, with scores ranging from 0.75 to 1.00. According to Tipi et al., (2009) sample rice farms might lower their inputs by 8% while still producing the same amount of rice.

In Crete, DEA was used to improve hotel efficiency. The findings revealed that domestically branded hotels were the most efficient, while internationally branded hotels were the least efficient, with hotels operating under a local brand and independent hotels falling somewhere in the middle Manasakiset al., (2013).

The DEA Method was used to assess the efficiency of the Air Navigation Services System. The findings demonstrated that the average efficiency score improved gradually from 2009 (0.589) to 2011 (0.752), as well as a growth in the number of efficient units, which peaked in 2011 Mara Ćujić et al., (2014).

Leverage, Technical Efficiency and Profitability: an application of DEA to foreign invested toy manufacturing firms in China. The empirical results supported the view that leverage has a positive effect on firm technical efficiency and that there was a positive relationship between technical efficiency and profitability Mok et al., (2007).

Estimating using DEA the Technical and Scale Efficiency of Spanish Urban Transportation. According to the conclusions of the study, the average pure technical and scale efficiencies for Spanish public transportation were 94.91% and 52.02%, respectively. The excess of resources was roughly 6%, and increasing the service's accessibility, one of the main components summarizing the huge number of output measures, was critical as a quality parameter in its performance Sánchez (2009).

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The DEA approach was used to assess the technical performance of Chinese railway administrations. The findings revealed that in terms of boosting technical efficiency, freight transportation was more essential than passenger transportation. The railway administrations in China's Middle and Western Regions were more efficient than those in China's Eastern Region. Technical advancements should be compatible with and coordinated with the manufacturing scale. Among all Chinese railway administrations, the Taiyuan Railway Bureau has the highest technological efficiency Li et al., (2019).

According to Agarwal et al., (2011), the technical efficiency of state transport undertakings in India was measured by DEA. Based on the findings of the study and the current state of technical efficiency, it was concluded that the STUs' performance was good but far from optimal. The average overall technical efficiency (OTE) was 83.26%, implying that an average STU can produce the same output with 16.74 %fewer inputs that they now have.

DEA was used to assess the efficiency of transit transport corridors in landlocked African countries. The findings revealed that the average pure technical and scale efficiency ratings were 90.89% and 37.13%, respectively, in this study. Two units (13.33%) were technically efficient (both in terms of technical and scale efficiency), while four units (26.66%) were only technically efficient Fanou et al., (2017).

Over the observed period, two units (13.33%) were technically efficient (both technical and scale efficiency), while four units (26.66%) were just purely technically efficient. Throughout the monitored years, Swaziland was the most efficient route, while the Central African Republic was the least efficient. The findings highlight the need of lowering trade costs to boost exports in landlocked countries Fanou et al., (2017).

The DEA Model was used to assess the marine economic efficiency of China's coastal provinces. According to Yan et al., (2020) the results show that Tianjin, Shanghai, Jiangsu, Fujian, and Shandong have higher economic efficiencies, Liaoning and Zhejiang have lower economic efficiencies, and Hebei, Guangdong, Guangxi, Hainan, and other provinces were in the middle.

Based on a DEA Model, an efficiency analysis of the marine economy in the Guangdong–Hong Kong–Macao Greater Bay Area. This study found that the GBA's marine economic efficiency was low, with average efficiency values of less than one; the average value of Guangdong's marine economic efficiency was the highest, while that of Hong Kong's was the lowest, showing that they were inefficient state Wen et al., (2020).

DEA and the Malmquist Productivity Index were used to calculate port efficiency and productivity. The CCR and BCC models of the DEA show that the average efficiency scores were 0.885 and 0.925, respectively, and that Shanghai, Shenzhen, Ningbo, Rotterdam, Antwerp, and Tianjin ports have the best performance in each model Baran et al., (2015).

Evaluation of the efficiency of shipping brokers' container operations in Spanish ports. Some of these variables, such as the number of container lines with which it operates, were found to be significant in the results. Belonging to one of the four dataset clusters appears to have a considerable impact on the efficiency of the investigated agents Gutiérrez et al.,(2015).

DEA was used to examine the efficiency of selected Australian and international ports. According to the findings, Melbourne, Rotterdam, Yokohama, and Osaka ports were the least efficient in the sample Tongzon , (2001).

DEA was used to assess port efficiency. According to the findings of the investigation, three ports were judged to be 100 percent efficient. In terms of container throughput, the two most efficient ports were also the world's number one and two ports Valentine et al., (2001).

DEA was used to evaluate the performance efficiency of the Taiwanese shipping industry. The empirical findings demonstrate that using financial ratios to evaluate performance efficiency in the shipping business in Taiwan can be more comprehensive LIN et al., (2005).

The DEA technique was used to evaluate the technical effectiveness of a logistics organization. Only two of the twelve warehouses analyzed were working efficiently, according to the results of a performance evaluation of a logistics company with twelve warehouses as DMUs Prusa et al.,(2020).

DEA was used to assess the efficiency of logistical processes in customs procedures. The study focused on the effectiveness of customs administration, with fourteen customs houses studied and measured. The study's findings demonstrate that a large number of customs officers were to blame for the inefficiency of customs houses, and it was suggested that in order to improve the efficiency of inefficient customs office need to increase number of realized customs procedures and reduce the number of customs Officers Kilibarda et al.,(2017). The researcher was interested in assessing the technical efficiency of CCAs at Dar es Salaam Port as they were the key player in contributing to the efficiency of the logistics performance index in the country specifically under competence and quality logistics services component.

In Thailand, the performance of customs Clearance agents was assessed. The DEA model's inputs were the unit price of the service, the rate of product loss or damage, the amount of time for late delivery, and the rate of an error on customs Clearance documents, while the model's output was the quantity of import cargo via customs airport. The evaluation revealed that there were two effective representatives and two ineffective representatives Emrouznejadet al., (2014).

A review of the literature has shown that DEA has been employed to assess technical efficiency in various fields such as education, agriculture, health, Marine economy, transport, banks, navigation, water, ports, logistics, shipping industry, customs and shipping and Clearance agents. It was very clear from the literature review that few have been done to assess technical efficiency in customs Clearance agencies worldwide and specifically at Dar es Salaam Port. However, the literature review gives comfort to apply the same techniques in assessing the technical efficiency of customs Clearance agencies at Dar es Salaam Port. CCAs play an important role in the overall efficiency of customs procedures, as well as supply chain management and logistics. Customs brokers, also known as CCAs, were responsible for the execution of imported/exported documents and merchandise from the Department of Customs. For every good passing through Tanzanian ports, these brokers play a crucial role for import and export enterprises. Efficiency assessment of CCAs was crucial for decision makers in purchasing companies and the entire supply chain management in the Country.

Customs Clearance was required for the import of foreign items to be sold domestically or for the import of raw materials to be utilized in the production of commodities. As a result, selecting appropriate CCAs becomes a critical issue that influences logistical operations in order to transport goods or provide services to clients. It's important to remember that the efficiency of supply chain management was largely dependent on the efficiency of CCAs' individual DMUs Emrouznejad et al., (2014).

2.3.2 Empirical Literature Review on Measuring Technical Efficiency- Tanzania

In the Face of Commercialization Developments, Technical Efficiency The evidence from Tanzania's Milk Producers was evaluated by the Drug Enforcement Administration the study's findings revealed that the average TE was around 80%, with variations between regions and largely reflecting levels of commer-

cialization. TE was raised by increasing the number of cattle, cows, and crossbreeds, as well as more veterinarian and feed inputs, assuming milk producers were rational Bahta et al., (2020).

The Policy Implications of Measuring Farm-Level Technical Efficiency of Urban Agriculture in Tanzanian Towns. According to the study's findings, a mean technical efficiency index of 0.72 was reached, meaning that output from urban agriculture production may be boosted by 28% utilizing currently available technologies. Despite their entrepreneurial skills, urban farmers faced a number of challenges when it came to resource allocation. Mwajombe et al., (2015) found that land size, total variable expenses, and extension service charges had a negative impact on the technical efficiency index.

DEA was used to assess the technical efficiency of faith-based hospitals in Tanzania. According to the findings on technical efficiency measures, the average efficiency index (for all hospitals) was 0.769 (76.9%), and the total number of technically efficient hospitals was 4 (26.6%).The results show that the VAHs' average annual technical efficiency was 59.79% in 2009, 60.01% in 2010, 57.49 % in 2011, and 55.08% in 2012, implying no progress in technical efficiency. However, most of the hospitals 73.33% have increasing returns to scale (IRS) which means therefore that if more resources were equally allocated to these hospitals (with IRS) there was a proportionate increase in production of health services hence catching up the production frontier Bwana (2015).

Analysis of Factors Affecting the Technical Efficiency of Smallholder Dairy Farmers in Njombe District was conducted through a stochastic frontier approach (SFA). The study found that the estimated TE ranged from 13% to 99 % with a mean of 45.46% and SD of 24.113%. Analysis of TE results revealed that the majority of respondents (61.7%) had TE below 50%. The implication of these findings was that the majority of the respondents were technically inefficient and that the value of dairy production could be increased by 54.54% through better allocation and use of available resources.

Furthermore, smallholder dairy farmers' TI was found to be positively related to their age, gender, education level, experience, selling to processors, membership in dairy production and marketing groups, off farm income, and dairy herd size, and inversely related to their marital status, use of hired labor, dairy training, extension contact, and selling on credit Mbehoma (2013).

The Cobb-Douglas stochastic frontier model was used to investigate the determinants of technical efficiency among smallholder coffee farmers in Tanzania's Kigoma region. The study revealed that inorganic fertilizers. Agrochemicals and labour were the key inputs. The mean technical efficiency index was 68%, indicating that farmers were technically inefficient, with a 32V'i, scope for increasing TE. The number of coffee trees and farmer's experience were the main determinants of TE Andrewet al., (2015).

2.4 Research Gap

Following a thorough evaluation of the available literatures, it was evident in the mind of the researcher that the available studies have greatly dealt with measuring, assessing, or evaluating technical efficiency in poultry egg production, tobacco farming, wheat farms, dairy farms, maize production, rice farms, broiler farm, Commercial Banks, transportation, Sports, faith based hospitals, higher education and etc. Little has been done in measuring, evaluating, assessing or determining the technical efficiency of key players on trade logistics.

All studies in the aforementioned context had different inputs resources and output resources under consideration. The only linking tool among those studies was the use of DEA in concluding what was technically efficient. Furthermore, the researcher noted that a study of evaluating the performance of customs clearance agents: A case study of Thailand as cited by Emrouznejad et al., (2014). The input in DEA from that study was Unit price of the service, rate of product lost or damaged, amount of times for late delivery, and rate of error on documents of customs clearance and while the output was the amount of import cargo

through customs airport. That study involved only 4 customs clearance agents and was specifically geared towards airport customs clearance on imports service. It was the aim of the researcher to address the gap of technical efficiency of customs Clearance agencies (CCAs) offering cargo Clearance services at Dar es Salaam Port, Tanzania.

The researcher wanted to give light to customs Clearance agencies (CCAs) on how to assess their technical efficiency in relation to input resources available and the output that were produced by the input invested in the service provision. This has not been readily available in the market for any Tanzanians who were interested in launching a CCA company to offer cargo Clearance services. Logistics performance was strongly linked to supply chain reliability and service quality, this research wanted to fill the gap in the efficient management of CCAs which were input to the effective trade logistics in the country. This was the product of researched and documented information to empower Managers of CCAs for efficient management of their Organization.

Concept and Assessment of Efficiency

Economic efficiency was defined as the complete elimination of economic waste, whether inputs were minimized for any observed level of output, outputs were maximized for any observed level of inputs, or a combination of the two. The term economic efficiency refers to the ability of a company to maximize its Efficiencies in both technical and allocative processes.

The ability of a CCA to create the most possible output from a given bundle of inputs or to produce a given level of output with the smallest possible quantity of inputs was assessed by TE (Bradley et al.,2014). A producer was technically efficient if and only if creating more of some product without producing less of another or consuming more of some input was impossible. As a result, TE was an assessment of a DMUs success in creating maximum output from a given set of inputs in terms of the production function that links the level of various inputs.

This research was mainly concerned with assessing how CCAs were able to maximize their service output with respect to the available input resources during the provision of cargo Clearance services. The study went further analyzing how individual available inputs resources were contributing to the overall technical efficiency of the CCA

2.6 Specification and Estimation of the Empirical Model

This study uses DEA to assess the technical efficiency of CCAs. Overall technical efficiency (TECCR), pure technical efficiency (TEBCC), and scale efficiency were the three types of efficiency in DEA (SE).More than a thousand scientific publications have since been published, and researchers have applied DEA to practically every sector of the economy, (Heidari et al., 2011).

2.7 Conceptual Framework

The quantity of products and services produced in a given time period is referred to as output in economics. As a result, understanding economic production swings was crucial for long-term growth. Increases in growth and inputs in factors of production were among the elements that impact changes in economic output. Variations in economic output were caused by anything that causes labor, capital, or efficiency to rise or fall.

Technical efficiency measures how much of the goods and services were produced in respect of the available input resources during the production of goods and services. This research was geared at assessing the technical efficiency of CCAs subject to the available resources during the provision of services. The volume of goods or services provided at a given period of time in respect to the available resources was the output to such a firm or industry.

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In the context of this study, the researcher conceived that the efficiency of customs Clearance processes apart from other factors was dependents on the efficiency of CCAs. Furthermore, the efficiency of an individual CCA as an independent decision making unit, was largely dependent on the optimal utilization of variable resources (inputs) made available to provide reliable and dependable goods or services. That was, the optimal service output of cargo volume as a result of optimal use of input resources (Office space in square meters, number of staff employed by the CCA, number of staff with professional training in (logistics/shipping) by the CCA, number of computers owned by the CCA and number of computer equipment networked with the cargo Clearance systems such as (TANCIS and Cargo System etc.). It was believed by the researcher that the CCAs were likely to be technically efficient only and only if they can optimally have utilized these available input resources to produce the optimal service output (cargo volume in tons)

Therefore, the dependent variable on this conception was, the cargo volume (tons) and the independent variables were (Office space in square meters, number of staff employed by the CCA, number of staff with professional training in (logistics/shipping). That was, five independent variables (input resources) and one dependent variable (service output)

The relationship between the independent variables (inputs resources) and the dependent variable (output) was depicted in the conceptual framework in figure 2-1.

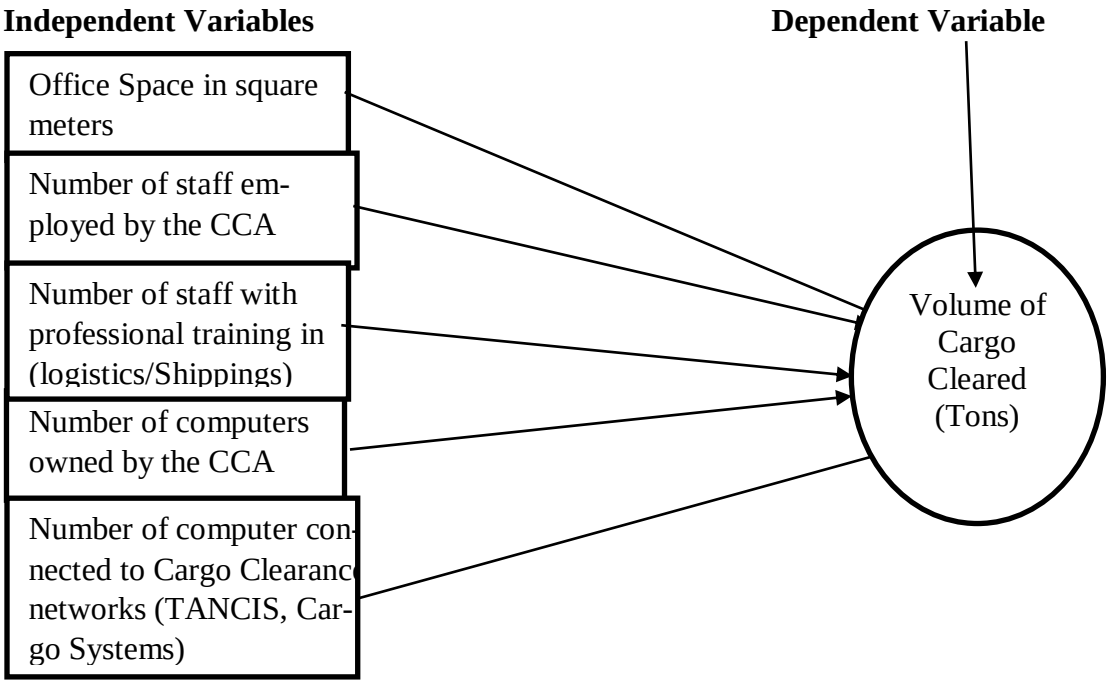

Fig. 2.1: Conceptual Framework

Author (2021)

The preceded conceptual framework does not necessitate the assumption of a functional form that connects inputs resources and outputs. CCAs were independent decision-making units in supply chain management under this conceptual framework, and they were directly compared to a peer or group of peers. The researcher concentrated on assessing the technical efficiency of CCAs offering cargo Clearance services in Tanzania because they have an overall impact on trade logistics and supply chain management. CCAs played a great role in trade logistics and therefore it was of paramount interest to the researcher to examine their technical efficiency as opposed to inputs resources that were made available in the business operations.

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2.8 Summary

The chapter covered the introductory part, theoretical literature review and empirical literature review showing out what has been done in the field in relation to assessment of the technical efficiency. The chapter gave further empirical evidence in the context of assessing technical efficiency of decision making units in their day to day business operations. Furthermore, it covered the knowledge gap elaborates on the existing gap in the field specifically in Tanzania in relation to assessment of Organizational technical efficiency, theoretical framework and conceptual framework.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The methodologies employed by the researcher in collecting data and information for the research study was detailed in this chapter. The study's scope, research design, data gathering methods, sample size, sampling procedures, and data analysis methodologies were all included. Research technique was a method of conducting research that uses a random sample strategy.

3.2 Study Area

The study area for this research was at Dar es Salaam Port specifically Dar es Salaam because nearly all CCAs were located in the business city of Dar es Salaam, due to the fact that Dar es Salaam Port attract the majority of cargo Clearance services in the country.

3.3 Research Design

In order to achieve the intended results from this research, the researcher adopted systematic sampling techniques during the selection of CCAs to be included in the assessment of technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port. To obtain the required data questions relevant to respond to general objectives, specific objectives and the research questions were developed. The researcher used questionnaires and interviews to obtain the relevant data which were later subjected to Data Envelopment Analysis Programme (DEAP/DEA) version 2.1 as an analytical tool through which data were analyzed. DEAP analytical tool applies linear programing analytical techniques to find out the solution for input resources that would produce optimal service output. The results from DEA data analysis were in the form of descriptive statistics in response to the independent and dependent variables. Lastly, data analysis results were presented in forms of tables, bar charts and pie charts to enable easy interpretation of the findings.

3.4 Research Approach

This was a quantitative research project. All the identified variables were measurable and easily quantifiable. The DEA was used to analyze the data and it generated descriptive statistics in respect to each variable which was identified and subjected to such rigorous linear programing model of data analysis. The intention of this research process was to find the optimal solution for each identified resource inputs concerning to the optimal output.

Inferential, experimental, and simulation techniques to research can all be characterized as quantitative research methods (Kothari 2004).The DEAP convert the presented data into the relative value of one, this was therefore a kind of simulated data to an artificial feature through which the data was supposed to be accounted as efficient. This enabled the dynamic behavior of each CCA's efficiency performance about Customs Clearance services as autonomous DMUs to be observed. The CCAs were observed on how their technical efficiencies were optimized regarding the available resource inputs. In business and social science applications, the term simulation refers to the operation of a numerical model that depicts the structure of a dynamic process. The simulation was done to simulate the behavior of the process over time given the values of beginning circumstances, parameters, and exogenous factors. This may also create models to forecast future situations of CCAs and other organizations and analyze their efficiency as individual decision making units (DMUs) in relation to their business environment using this technique.

3.5 Target Population

Every study must have a targeted population where its study sample must be drawn out. In this case, the target population was the CCAs registered under registered shipping services providers under TASAC. TASAC has registered nearly more than eight hundred (800) CCAs.

3.6 Sampling Techniques

Because of its simplicity and capacity to eliminate clustered selection and limit the risk of data contamination, the systematic random sampling technique was used in this study. Tanzania Shipping Agencies Corporation had registered nearly more than eight hundred (800) CCAs from which a sample for this study was drawn.

3.7 Sample Size

A sample was the number of individual cases that you finally draw and from which/whom you collect data Leavy (2017). It was from the TASAC CCAs registration register, a sample of sixty-three (63) CCAs was drawn out and studied as an independent unit for the duration of one year. The sample size is easily calculated from online sample calculators. The basic assumptions that were considered by the researcher before calculating the sample size were described in the next paragraph.

The basic assumption in the mind of the researcher were that the proportion of CCAs with technical efficiencies in the population was 50% of the whole population. It was also supposed that the CCAs that were technically efficient have a confidence level of 90% and a margin error of 10% (Table 3-1). Furthermore, it was assumed that CCAs were not normally distributed and therefore, the nonparametric approach model was employed towards assessing their technical efficiency. It was also assumed that the CCAs were homogeneous in terms of inputs required to become technically efficient.

S/N	Category	Size
1	The population of registered CCAs from which the sample was drawn	800
2	Proportion of CCAs which were technical efficiencies in the population	50%
3	Confidence level of technically efficiency CCAs	90%
4	Margin error	10%
5	Sample/Number of CCAs to be studied	63

Table 3.1: Showing Assumptions Considered During Determination Of Sample Size For The Study

Source: www.calculator.net/sample-size-calculator.html

The sample size was found to be 63CCAs out of the registered 800 CCAs by entering the fundamental assumptions in the online calculator and the population size of the target population.

3.8 Data Collection Methods

The researcher employed both questionnaires and interviews to complete this study. The registered CCAs were the primary source of information in relation to their technical efficiency through designed questionnaires and interviews. The questions in the questionnaires and interviews aimed at obtaining data for the identified parameters in the conceptual framework. The data necessary for assessing technical efficiency of CCAs in this study were(office Space in square meters, number of staff employed by CCA, number of staff with professional training in (logistics/shipping), number of computers owned by the company, number of computer equipment networked with cargo Clearance systems (TANCIS, Cargo Systems etc,). The aforementioned input data were treated as independent variables in the conceptual frame work and the volume of cargo handled in tons was treated as a dependent variable respectively. The responses from the chosen sample were captured in the following manners as summarized in Figure 3-1.

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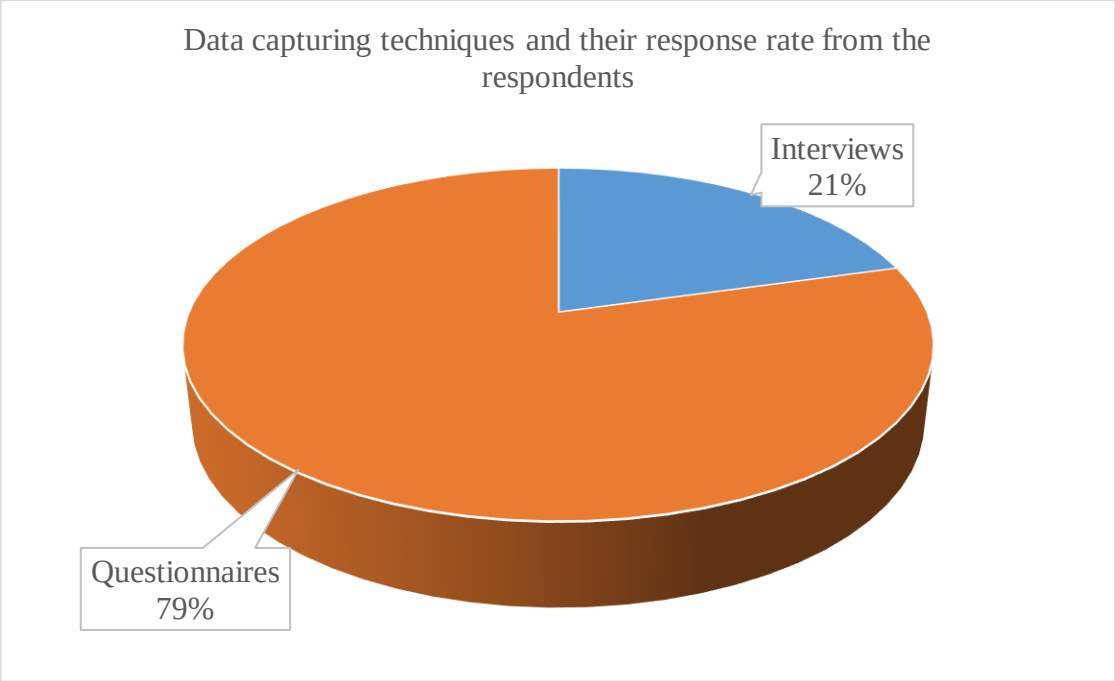

Fig. 3.1: Showing Data Capturing Techniques and the Response Rate From the Respondents.

3.9 Pilot Study

Data collection tools were pre-tested before the main data collection exercise by sending prior questionnaires and interviews for some of the head of CCAs. The response from the prior questionnaire provide evidence on how the response could be. The questionnaire was lastly shared with the 63 sampled CCAs from the TASAC register. The pilot study provided primary information on how data were to behave if the main data collection exercise could start. The pilot also guided the researcher to modify the independent variables on some kind (Table 3-2).

S/N	Independent variable before pilot study/Input resources to CCAs	Independent variable after alteration
	Office Space in sq. meters	Office Space in square meters
	Number of staff with shipping/logistics training qualifications	Number of staff employed by the CCA
	Number of staff with none- shipping/logistics training qualifications	Number of staff with professional training in (logistics/Shipping)
	Number of computers connected to Customs /cargo Clearance computer	Number of computers owned by the CCA
	Number without connection to customs/cargo Clearance computer systems	Number of computer connected to Cargo Clearance networks (TANCIS, Cargo Systems)

Table 3.2: Independent Variable Before Pilot Study And After Pilot Study

3.10 Data Analysis

The researcher subjected data collected from the field to DEA techniques for processing because from the axioms and foundations of DEA in production theory was a well-established approach for assessing the performance of a homogeneous set of data. The DEA technique was a fundamental linear programming method for estimating relative manufacturing unit efficiency. Recent researches have used DEA in eco-

nomic, energy, and environmental modeling. Parlakay et al. (2016) analyzed the production cost and technical efficiency of sunflower-growing businesses under dry conditions using the DEA approach.

DEA which was concerned with the estimation of technical efficiency and efficient frontier, was first proposed by Charnes, Cooper, and Rhodes (CCR) (1978) as an extension of ideas of Farrell (1957). It was a linear programming technique (i.e., a "non-parametric" frontier estimation methodology and a "data-oriented" approach) for evaluating the relative efficiencies and performance of a group of related comparable entities (a set of peer entities called Decision Making Units or DMUs) in converting inputs into outputs.

DEA was a powerful quantitative method for obtaining relevant information regarding the efficiency and performance of businesses, organizations, and a variety of functionally identical, semi-autonomous operating units. The domain of DEA can be any collection of numerous entities with the same set of multiple attributes, making it useful for assessing when there were multiple inputs and outputs and no standard acceptance weights for aggregating inputs and outputs Yun et al., (2004) and Goksen et. al., (2015).

In general, DEA was referred to as a nonparametric technique since it does not require a functional form of the efficient frontier and, as a result, no parameter estimation, making it applicable to a wide range of applications. DEA classifies entities as "efficient" or "inefficient" based on their geographic location relative to an empirical efficient frontier. The comparison was made solely between members of the relevant group. DEA informs decision-makers about how well subordinate units convert the resources they manage locally into the outputs required to complete the operation's purpose.

3.11 Comparison between DEA and SFA

The literature provides two major ways for creating efficiency frontiers, parametric and non-parametric, on which other units' efficiency scores can be based. Neither of these approaches was superior to the other; each has its own set of benefits and drawbacks.

Despite the fact that each strategy has ardent supporters, the choice of one over the other was based on the specific circumstance at hand Raj (2014). The essentials difference among these methodologies, from which their advantages and disadvantages arise, can be summarized in Table 3-4as they were discussed by Trujillo et al., (2013).

Data Envelopment Analysis (DEA)	**Stochastic Frontier Analysis (SFA)**
Non-parametric approach	Parametric approach
Deterministic approach	Stochastic approach
Does not consider random noise	Consider random noise
Does not allow statistical hypothesis to be contrasted	Allow statistical hypothesis to be contrasted
Does not carry out assumptions on the distribution of inefficiency term	Carry out assumptions on the distribution of inefficiency term
Does not include error term Includes a compound error term	Includes a compound error term: One of one side and the other asymmetrical (two queues)
Does not require specifying a function form	Requires specifying a function form
Sensitive to the number of variables, measurement errors and outlier	Can confuse inefficiency with a bad specification of the model
Estimation Method: Mathematical Programing	Estimation Method: Econometric

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Table 3.3: Characteristics of DEA and SFA
Source: González and Trujillo (2009) as cited in Trujillo et. al. (2013)

The application of DEA methodologies (Linear Programming Models) was the subject of this dissertation, which was based on the following arguments: When numerous inputs and outputs were encountered, Raj (2014) believes that DEA was a powerful instrument that has been utilized for decades in assessing productivity/efficiency and has a wide range of applications. One advantage of DEA was that each relatively inefficient (less than 100 percent efficiency) unit was benchmarked exclusively with units that were considered to be identical to it but nonetheless efficient, providing a way for the relatively inefficient units to become efficient. Raj (2014) goes on to say that "DEA has shown to be a very strong tool in benchmarking DMUs." Among the various standalone methodologies for determining DMU efficiency, DEA outperforms the majority, if not all."

Furthermore, Yang et al. (2000) stated that DEA was designed to identify the best practice DMU without prior knowledge of which inputs and outputs were most important in determining an efficiency measure (i.e., score) and assessing the extent of inefficiency for all other DMUs that were not considered best practice DMUs. Despite this, academics in the existing literature on the applicability of SFA and DEA methodologies believe that the DEA approach was best because it was non-parametric and does not require an explicit a priori definition of correlations between inputs and outputs. Furthermore, DEA necessitates the establishment of strict priority weightings for the various elements. It also has the benefit of having a model for evaluating efficiency that was objective (Wu and Goh, 2010) "DEA was a nonparametric approach of assessing the efficiency of CCAs as an independent decision-making unit (DMUs) like as a corporation or a public-sector agency, initially introduced into the OR literature by Charnes, Cooper, and Rhodes," according to Panayides et al. (2009). Different organizations, departments, or groups can serve as decision-making units (DMUs), all with identical functions, aims, and market sectors.

3.12 Mathematical Expression of DEA Model

DEA was created to identify the best practice decision making units (DMUs) in service provision without knowing which inputs and outputs were most important in determining an efficiency measure (i.e. score) and determining the extent of inefficiency for all other decision making units (DMUs) that were not regarded as the best practice DMUs (Panayides et. al., 2009). The Linear Programming solution to a DEA problem creates no standard errors and gives no possibility for hypothesis testing because it was non-statistical in nature. Any deviation from the frontier was viewed as an inefficiency in DEA, and random shocks were not allowed (Panayides et. al., 2009).

Being non-statistical in nature, the Linear Programming solution of a DEA problem produces no standard errors and leaves no room for hypothesis testing. In DEA, any deviation from the frontier was treated as inefficiency and there was no provision for random shocks Panayides et. al., (2009).

The following model shows how the relative efficiency score of decision making units (DMUs) was calculated, as proposed by Charnes et al. (1978) based on Farrell's 1957 seminar paper and later adopted by others Panayides et. al., (2009), Dycket al (2015), and Kalgora et. al., (2019). They suggested the following mathematical programming for estimating a given DMUj's relative efficiency score among similar n entities being assessed.

$$DMU_j = \frac{u_1 y_{1j} + u_2 y_{2j} + \cdots + u_r y_{rj}}{v_1 x_{1j} + v_2 y_2 + \cdots + v_i x_{ij}} = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{r=1}^{m} v_i x_{ij}} \leq 1, j = 1, \ldots n \quad (1)$$

$u_r, \ldots u_s > 0$ and $v_i \ldots v_m \geq 0; r = 1, \ldots, s, \ i = 1, \ldots, m$

Where

y_{rj}= amount of output $\boldsymbol{r}$ produced by DMU_j

x_{ij}= amount of input $\boldsymbol{i}$ utilized by DMU_j

r = number of outputs generated by DMU_s

i = number of inputs used by DMU_s

u_r= weight given by DEA to output $\boldsymbol{r}$

$\boldsymbol{v_i}$ = weight given by DEA to input **i**

Using the Linear Programming Model (LPM1) to convert the above estimations:

$max \ \sum_{r=1}^{s} u_r \, y_{r0}$ (2)

Subject to $\sum_{r=1}^{s} u_r \, y_{ij}$ - $\sum_{i=1}^{m} v_i \, x_{ij} \leq 0$, j= , …, n (3) $\sum_{i=1}^{m} v_i \, x_{ij} = 1$

$u_r, v_i \geq 0$

The problem above, known as the "CCR ratio model," can be reduced and translated to the Linear Programming Model, (LPM2), as shown by Panayides et al. (2009). The following was the formula for the DEA model (LPM2):

$max \, \theta_p \, (u_r, v_i) = \sum_{r}^{s} u_r \, y_{rp}$ (4)

$subject \ to \ \sum_{i=1}^{m} v_i \, x_{ip} = 1$ (5)

$$\sum_{r=1}^{s} u_r \, y_{rj} - \sum_{i=1}^{m} v_i \, x_{ij} \leq 0; j = 1, \ldots, n$$

$$u_r \geq \varepsilon, i = 1, \ldots, s$$

$$v_i \geq \varepsilon, i = 1, \ldots, m$$

Where $\theta_p$was the relative efficiency of the p^{th} DMU

The DEA-Charnes, Cooper and Rhode (CCR) and DEA-Banker, Charnes and Cooper (BCC) Models were created by combining the two models (LPM1 and LPM2), with DEA-CCR assuming Constant Return to Scale and DEA-BCC accommodating technologies with Variable Return to Scale. The efficiency of DMU was maximized by solving the above Equations, subject to the efficiencies of all DMUs in the set, with an upper bound of 1.

The preceding model was solved *n*-times to establish each DMU's relative efficiency, with the weightsu_r and v_i treated as unknown variables whose values were calculated optimally by maximizing the

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efficiency of the targeted DMU. A score of 1 shows that the DMU in question was efficient in comparison to other DMUs, whilst a score of less than 1 indicates that the DMU in question was inefficient Panayides et. al., (2009); and Van Dyck,(2015).

In a larger sense, DEA translates each decision-making unit's (DMU) many incommensurable inputs and outputs into a scalar measure of operational efficiency in comparison to rival DMUs. Due to the fact that DEA was a relative measure, it will only distinguish the least efficient DMU from the entire collection of DMUs. A port authority's ability to change a set of inputs (provided resources) into a set of outputs was represented by an efficiency score. The aforementioned model also identifies an inefficient DMU's peer group (an efficient DMU with the same weights). To put it another way, the best practice (most efficient) DMU was given a score of 1, whereas all other less efficient DMUs were given a number between 0 and 1Min et al,(2004 and Yang et al., (2000.

3.13 Validity and Reliability

Better research results come from data that were valid and reliable depending much on the methods of data collection. Furthermore, reliable research results depend on the validity of research instrument employed in the field. The researcher ensured that the data were collected from authoritative CCAs with authorized registration from the regulating authorities with the valid and tested research instrument which were questionnaire and interviews. This was one of the best strategies that ensured validity and reliability of the information used for the analysis of CCAs technical efficiency.

3.14 Limitations that Influence Research Methodology

The following limitations influenced research methodology. Firstly, it was the issues of sample and its selection. It was limiting factor which caused an insufficient sample size for statistical techniques to be applied and therefore, DEA was the only best and appropriate method to avoid statistical estimations. Second, there was a shortage of past research papers on the subject specifically in the area of assessing technical efficiencies of CCAs offering cargo Clearance services at Dar es Salaam Port. Finally, cultural bias and other personal difficulties had an impact on the data's quality and reliability.

3.15 Summary

This chapter detailed the methodology for completing the study to its conclusion. The chapter covered: introduction, study area, research design, research approach, population, sample size and sampling techniques, data collection methods / data sources, pilot study, data analysis, validity and reliability, and research methodological limits.

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CHAPTER FOUR

DATA ANALYSIS, PRESENTATION ANDINTERPRETATION

4.1 Introduction

This dissertation analyzes the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port using the DEA model on data collected from 63 CCAs. Since all CCAs were in the same country, a fair Comparison among them was achieved through almost the same economic conditions where they operate at Dar es Salaam Port.

4.2 Data Selection

The CCAs depend on the efficient use of resources Office spaces, labor and other ICTS related tools, therefore the input data used include the rented office spaces (in square meters), the number of staff with the right professional qualifications (in logistics/shipping related qualifications), the number of ICT equipment deployed in operations. Therefore, the following key variables were of interest to the researcher.

- *Dependent Variable*: Cargo volume (in Metric Tons). The assumed that cargo volume was dependent on the resources allocated to the CCAs for provision of its services. These resources are treated as independent variables. And therefore the independent variables were as described in the next paragraph.
- *Independent Variables*: Office Space (in square meters); the number of employees; number of professional staff with logistics /shipping professionals; the number of ICTs related equipment owned & networked with TANCIS, Cargo Systems and other cargo Clearance related computer systems. For the purpose of this research, the output variables to measure the efficiency of a CCA werethe volume of cargo cleared in metric tons (i.e. the number of goods). Cargo cleared in metric tons was used because it was the primary source of Comparison between CCAs.

4.3 Summary Representation of Data Characteristics from the 63 Sampled CCAs

After the data collection exercise had been completed, the researcher carried out simple data characteristic check. This involved looking at the measure of dispersion or measure of variability. It is concerned with describing the spread of data around the mean. Under this the researcher looked at the range.

First, it was noted that the assessed CCAs occupied Office space in square meters ranging from 25 square meters as a minimum value to 120 square meters as a maximum value (Figure 4-1).

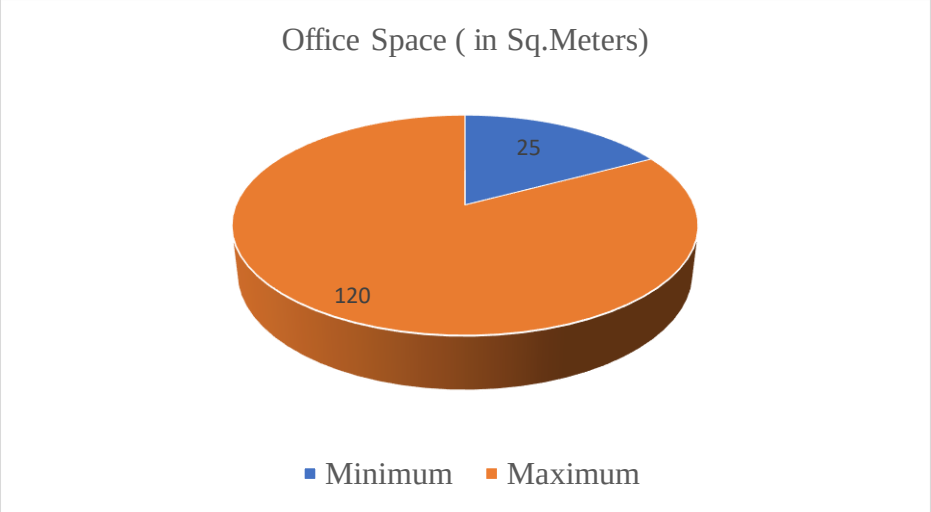

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Fig. 4.1: Office Space Data characteristics

The measure of the variability of data from average square meters a CCAs could have an office space was 29.94 square meters. The average office space a CCA had was 67.49 square meters. The frequently occupied office space was 45 square meter for the 63 investigated CCAs as shown in the pie Figure 4-1 and Table 4-1.

Second, the minimum number of staff employed by the CCA was 8 and its maximum number of staff was 53 (Figure4-2). The variation in the number of staff employed by one CCA from the average number of staff which could be employed by the CCAs was approximately 14 staff. The average number of staff a CCA could employ was 26 staff.

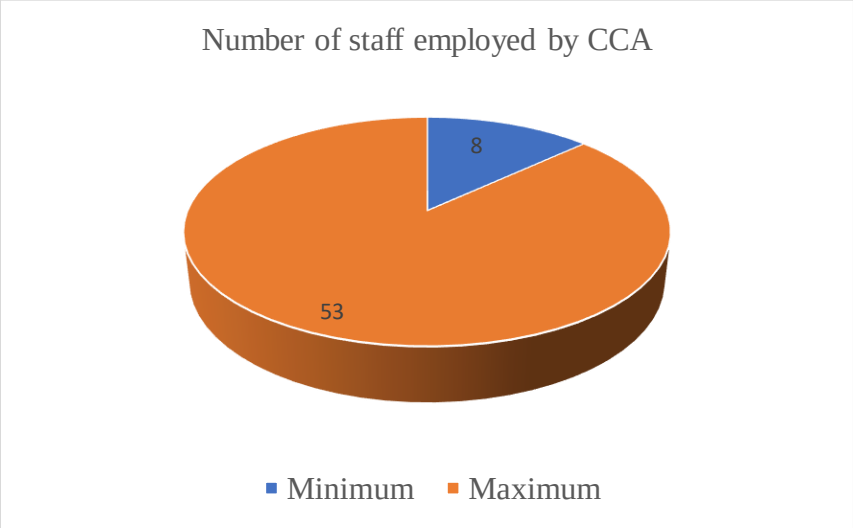

Fig. 4.2: Staff Employed Data characteristics

Third, the minimum number of professional staff with training in logistics or shipping was 2 and the maximum number was 25 staff (Figure 4-3). The variation of one CCA to employ staff with professional training in logistics or shipping from the average number of staff that a CCA could employ was approximately 6 staff. The average number of staff a CCA could employ was approximately 8 staff.

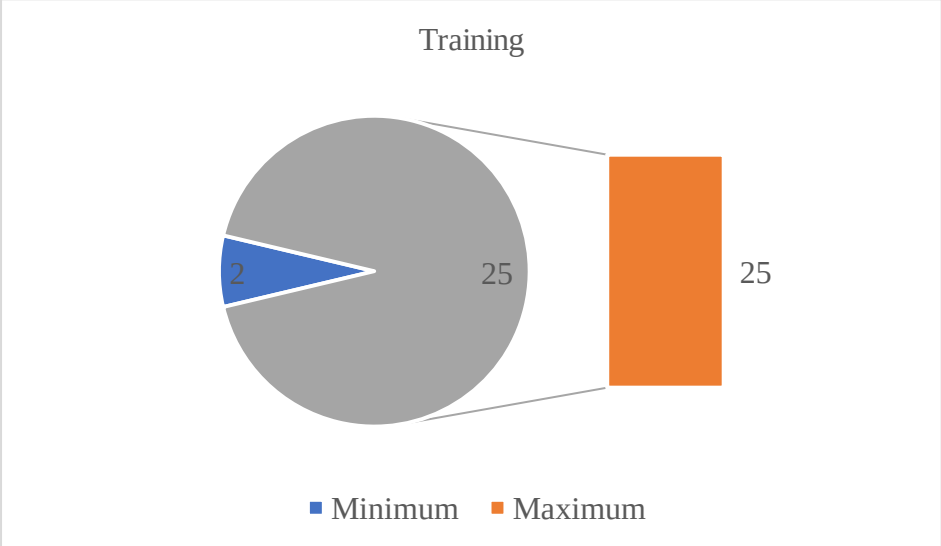

Fig. 4.3: Number of Staff with professional Training Data Characteristics

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Fourth, the collected data have shown that the minimum number of computers a CCA could have been 3 computers and the maximum number was 25 computers. The variation of computer possession of one CCA from the average number of computers a CCA could have was approximately 4.66 computers. Also it was shown that the average number of computers a CCA could possess was 11computers while the frequently number of computers owned by CCAs was 10 (Figure 4-4).

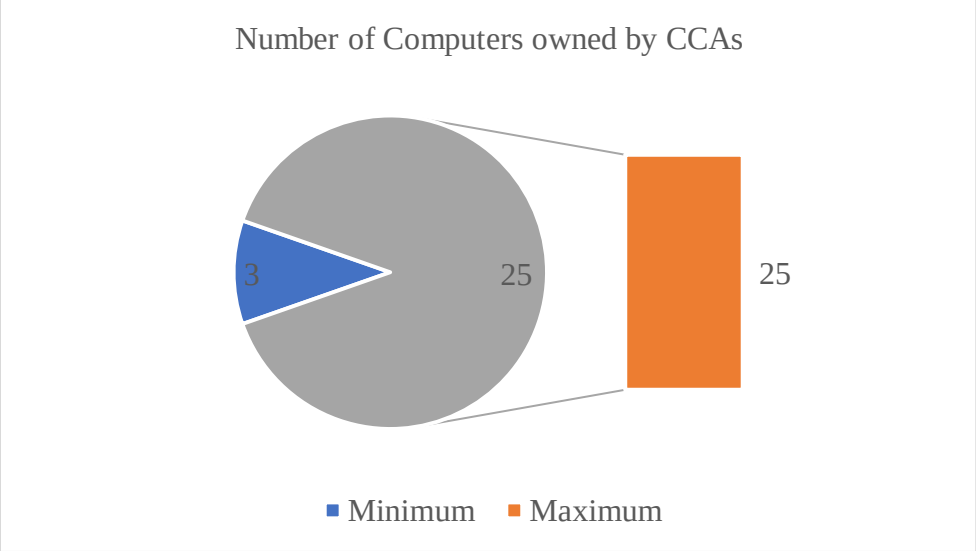

Fig. 4. 4: Number of Computers Owned By CCAs Data Characteristics

Fifth, the data collected has shown that the minimum number of a computer owned by CCA and connected to cargo Clearance systems such as TANCIS and Cargo systems were 3 and the maximum number was 15 computers. The variation of owning computers connected to cargo Clearance systems such as TANCIS and Cargo System from the average possession of such computers was approximately 4 computers. The average number of computers a CCA could connect to the cargo Clearance Systems such as TANCIS and Cargo systems were approximately 10 computers (Figure 4-5).

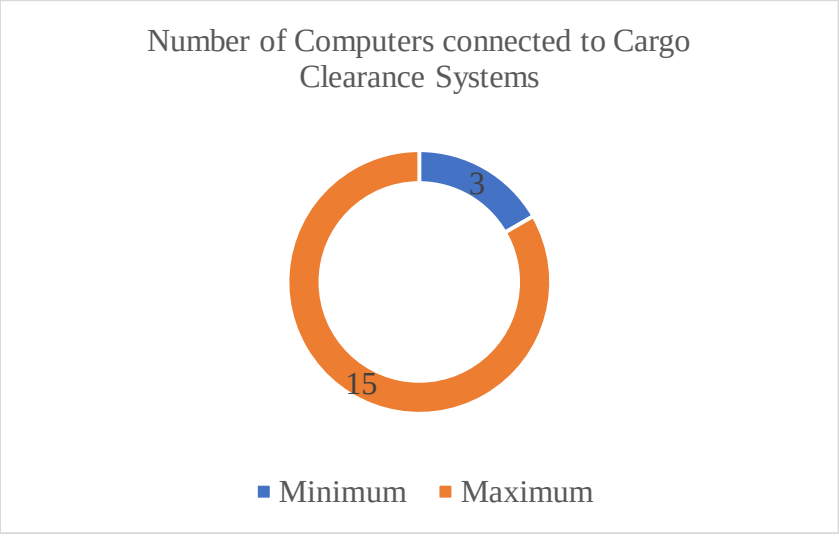

Fig. 4.5: Number of Computers Connected To Cargo Clearance Systems CCAs Data Characteristics

Sixth, it was observed from the collected data that the minimum cargo volume a CCA cleared was 10,000 tons and the minimum amount of tonnage was 85,000 tons. The variability of cargo volume a CCA could handle from the average cargo volume a CCA handled was approximately 16, 793 tons. The average

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cargo Clearance capacity for the sampled CCAs was 70,000 tons. The frequent cargo volume in tonnage CCAs handled as 70,000 tons (Figure 4-6).

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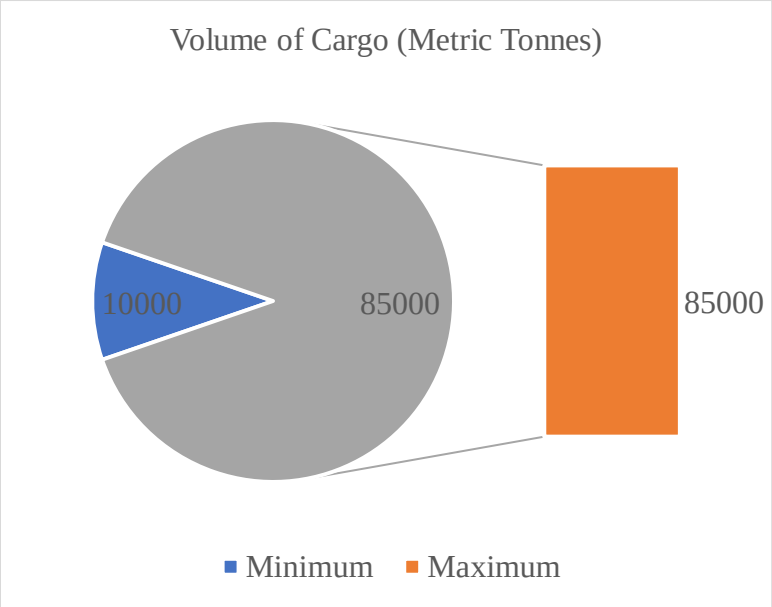

Fig. 4.6: Cargo Volume in Metric Tons Data Characteristics

Parameters measures	Office Space (in Sq. Meters)	Number of staff employed by CCA	Number of Staff with professional training (logistics/Shipping)	Number of Computers owned by CCAs	Number of Com-puter connected to Cargo Clearance Networks	Volume of Cargo (Metric Tons)
Minimum Value	25	8	2	3	3	10000
Maximum Value	120	53	25	25	15	85000
Standard Deviation	29.94	13.92	5.56	4.66	3.75	16793.47
Mean	67.49	26.17	7.97	11.02	10.21	49326.51
Mode	45	15	5	10	10	70,000

Table 4.1: Summarizes the Data Characteristics from the 63 Sampled CCAs Which Were Assessed Under This Study

Data characteristics summarization has not been common on most of the literature reviewed concerning the assessment of technical efficiency of various Organization. The researcher found it was worth noting data characteristic before going deep into other analyses using the targeted analytical tool. In the context of this study the researcher applied DEA as his analytical tool. DEA was an effective instrument in the operations research methodology, used to elicit efficiently performing business units. DEA was a well-established technique for identifying efficient production frontiers in many fields of study (Manzoni, 2009).

4.3 Operationalization of Variable and Empirical Analysis

The DEA model can be divided into several types depending on the nature of the applied problem and characteristics of given data. The typical basic models widely used were DE Constant Return to Scale (CRS) based on input and output oriented CCR model and DEA Variable Return to Scale (VRS) based on input and output oriented BCC model (Park and Zheng, 2016). To this effect, the efficiency analysis for the proposed CCAs in this study was performed using the output oriented CCR and BCC models. Reviewing from the previous studies, it was evident that the selected variables were highly associated with assessing the CCAs technical efficiency. The data used in this study include cargo volume in metric tons; office space in square meters; the number of employees recruited by the CCA company; the number of staff recruited by the CCAs

with logistics/shipping professionals; the number of ICT equipment owned by the CCA (Computers); number of ICT equipment (Computer) networked to TANCIS, cargo systems and other cargo Clearance related systems all collected over one-year period (2020). The factors considered on selection of CCAs and variables were as follows: First, the CCA should be registered by regulating body (TASAC) for providing cargo Clearance services at Dar es Salaam Port. Second, the CCA should have a permanent registered office in Tanzania and more specifically in Dar es Salaam.

It was worth mentioning that being non-statistical in nature, the Linear Programing (LP) solution of a DEA problem produces no standard errors and leaves no room for hypothesis testing. In DEA, any deviation from the frontier was treated as inefficiency and contrary to SFA there was no provision for random shocks.

4.4 Data Analysis Results

4.4.1 Data Analysis Tool

The output-oriented DEA-CCR, DEA-BCC and Scale efficiency models were applied for the assessment of 63 CCAs offering cargo Clearance services at Dar es Salaam Port, a case study of Dar es Salaam Port. Data was collected for the year of 2020 with a sample of 63 CCAs through questionnaires and interviews and the results were subjected to a software developed by Coelli (1996) known as the DEAP version 2.1 for analysis purposes.

4.4.2 CCAs Technical Efficiency Scores under CRS

The general objective of the study was to assess the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port.

The main findings in this part were obtained by applying the assumption of variable returns to scale to each of the above-mentioned models (See Chapter 3). The technical efficiency scores revealed CCAs that were on the efficient (best practice) frontier (those with a score of one) and which were less efficient relative to CCAs on the frontier. In Comparison to best practice, the higher the score, the greater the potential improvement in output (with retaining inputs).

Only relative performance within the sample was considered for calculating technical efficiency scores. CCAs found with one efficiency rating are efficient in Comparison to all other CCAs in the sample, but not necessarily by some absolute or global criterion. Under this assessment, it was found that 9 CCAs were technically efficient with constant returns to scale (CRS) equivalent to 14% of the 63 sampled and studied CCAs. This implied that only 14% of the sampled CCAs were assumed to operate on perfect business competition market environment.

That was, the 14% of CCAs out of the sampled 63 CCAs were operating at an optimal level in the provision of cargo Clearance services at Dar es Salaam Port. Furthermore, for the 9 CCAs which operate optimally under the assumed perfect competition indicated that the proportion increase in all factor inputs of service productions (that was office space in square meters, number of employees, number of employees with professional training in logistics/shipping, number of computers owned by the CCA and the number of computers connected to cargo Clearance networks such as TANCIS, Cargo systems etc) lead to the same proportion increase of service outputs (that was cargo volume cleared by the CCA).

The findings revealed that 54 CCAs out of the 63 sampled CCAs equivalent to 86% were technically inefficient under the assumption of perfect competition business environment. This tells that the 54 CCAs out of the 63 studied CCAs have to adjust their input resources in order to acquire efficiency level required for optimal provision of services in cargo clearance. Form the results produced by DEA analysis shows that the 54 CCAs out of the 63 assessed CCAs had an average technical efficiency score of 0.66 which was equivalent to 66% and therefore, they have to reduce their input resources to attain technical efficiency by an average of 0.34 scores which was equivalent to 34%. The results further imply that the 54 CCAs can learn

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from the 9 CCAs how to optimally allocate input resources for effective operationalization of cargo Clearance services.

Competence and quality of logistics services—primarily in trucking, forwarding, and customs brokerage—are a crucial component in the calculation of the Logistics performance index Arvis et al., (2018).This component's efficient performance in the logistic performance index contributes to Tanzania's overall logistics performance indicator's efficiency. These findings support those of Arvis et al., (2018), who found that Tanzania underperformed on the aforementioned component from 2007 to 2016.Under the component of competence and quality of logistics services in the Logistics Performance index, CCAs were commonly known as customs Clearance agents or customs brokers. The inefficiency of the component of competence and quality logistics services was ascribed to the underperformance of the Tanzania Logistics performance index, according to these research findings. Figure 4-7 gives a summary of CCA which was relatively efficient.

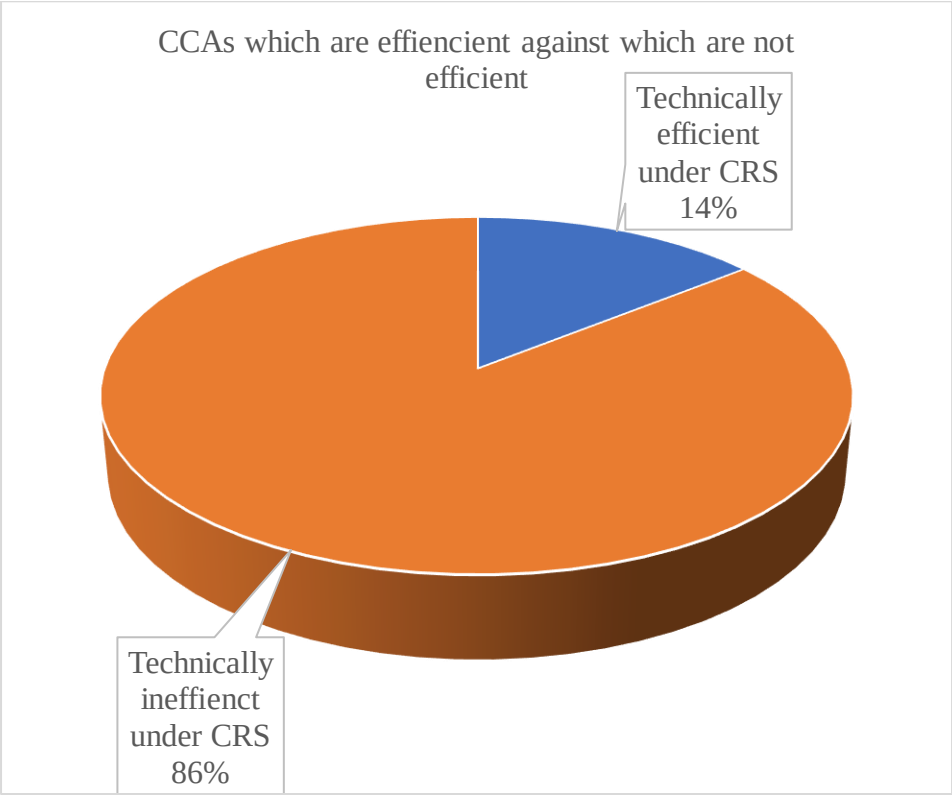

Fig. 4.7: CCAs Which Are Efficient Against Which Are Not Efficient

The efficiency of four customs Clearance agents was compared using the DEA methodology. The DEA model's inputs were the unit price of the service, the rate of product loss or damage, the number of times for late delivery, and the rate of an error on customs Clearance documents, while the model's output was the amount of import cargo via customs airport. The examination revealed that the customs Clearance agents had two efficient and two inefficient representatives (Emrouznejad et al., 2014). This study was the difference from the research findings under discussion and therefore it was not worth referencing its finding because it applied different inputs and its outputs although it used DEA for the data analysis. There were many other studies related to measurement, assessment or evaluation of technical efficiency all having variant inputs and outputs under scrutiny and therefore missing a link from one study to another. The only direct link from one study to another under the application of DEA is the interpretation of the efficiency scores both under CRS and VRS.

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4.4.3 The Impact of VRS on CCAs Technical Efficiency

In DEA variable returns to scale (VRS) is a sort of frontier scale. If an increase or reduction in inputs or outputs does not result in a proportional change in outputs or inputs, it is easier to estimate efficiency Cooper et al.,(2011). Returns to scale can be increased or decreased using this strategy. As a result, when working with the Data Envelopment Analysis Program, VRS may display increasing, constant, and declining returns to scale (DEAP).

In the case of this study, the models were first performed under the assumption of constant returns to scale (CRS).The assumptions were, (CCAs) operates under optimal scale in an environment with perfect competition. That the increase of output services was in exact proportion of the factor of production (office space(in square meters), number of staff employed by a CCA, number of employees with professional training in logistics/shipping, number of computers the CCAs owned and number of computer networking with cargo Clearance networks such as TANCIS, cargo systems, etc.).

Finally, each model was run under the premise of non-increasing returns to scale to assess the nature of any scale inefficiency. Increasing returns to scale occurs when the output increases by a larger proportion than the increase in inputs during the production process Banker et al., (2004). That was, the outcomes on the output services when the inputs in the provision of products or services were subjected to change by increasing/decreasing or staying constant were referred to as increasing, decreasing, or constant returns to scale.

According to this research it was found that37 CCAs, or 59% of the 63 examined CCAs their service outputs experienced decreasing returns to scale as per findings shown in Appendix VI of this study. This meant that for every proportion increase in input services (such as office space in square meters, number of employees, number of employees with professional training in logistics/shipping, number of computers owned by the CCAs, and number of computers networked with cargo Clearance networks such as TANCIS, cargo systems, and so on), 59 % of the sampled CCAs had lower returns on service output of cargo volumes cleared in contrast of the proportion increase of the inputs. This implied that the 59% of the sampled CCAs were subjected to changes in inputs for them to achieve the optimal provision of service. A decreasing return to scale demotivate service provider from expanding their services through restriction of input expansion and therefore this result in conformity with the claims that Tanzania was underperforming on the Logistical Performance Indicators (Arvis et al., 2018) from 2007 to 2016 specifically under the component of Competence and quality of logistics services—primarily in trucking, forwarding, and customs brokerage. The findings signified Management inefficiency. Tahir et al., (2009) argued that a firm that was efficient under VRS was considered technologically efficient; the VRS score represented pure technical efficiency (PT), whereas a firm that was efficient under CRS was technologically efficient and also uses the most efficient scale of operation. Scale efficiency (S) was derived from the measures of technical efficiency (T) and pure technical efficiency (PT).

Furthermore, it was found that 27% of the sample (CCAs providing cargo Clearance services at Dar es Salaam Port was experiencing an increasing return to scale as can be noted in findings shown in Appendix VI of this study. This meant that a proportional increase in the factor of service production (office space in square meters, number of employees, number of employees with professional training in logistics/shipping, number of computers owned by the CCAs, and number of computers networked with cargo Clearance networks such as TANCIS, cargo systems, and so on) resulted in a large increase in the volume of cargo cleared. These findings implied motivating CCAs to expand their business operations which in return had positive returns on their service output. Despite that implications, the findings signified that management of were efficient. Many pieces of literature reviewed had no similar studies with the same inputs and output although they applied DEA during data analysis one of such study was on the "*Evaluating The Performance of Customs Clearance Agents: A Case Study in Thailand"* cited by Emrouznejad et al., (2014). The study applied Data Envelopment Analysis (DEA) model to compare the efficiency of the 4 agents. The Unit price

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of the service, rate of product lost or damaged, amount of times for late delivery, and rate of an error on documents of customs Clearance were the inputs of the DEA model, while the amount of import cargo through customs airport was the output of the model. The result of the evaluation indicates that there were two efficient and two inefficient representatives. The study did not go further more than identifying which agent was efficient as compared to others and it comprised only four companies in the study. The researcher failed to obtain any literature which assessed the same technical efficiency of customs Clearance agencies with the same input categories although many various studies have been documented to assess technical efficiency on various sectors of production with varying inputs and output settings. That is why the researcher wanted to fill the gap on knowledge on this area specifically to Customs Clearance agents as the key players in the trade logistics. The researcher interpreted the implications of the findings under VRS in regards to economic and managerial perspectives. Figure 4-8 gives a simple presentation of the descriptions narrated above.

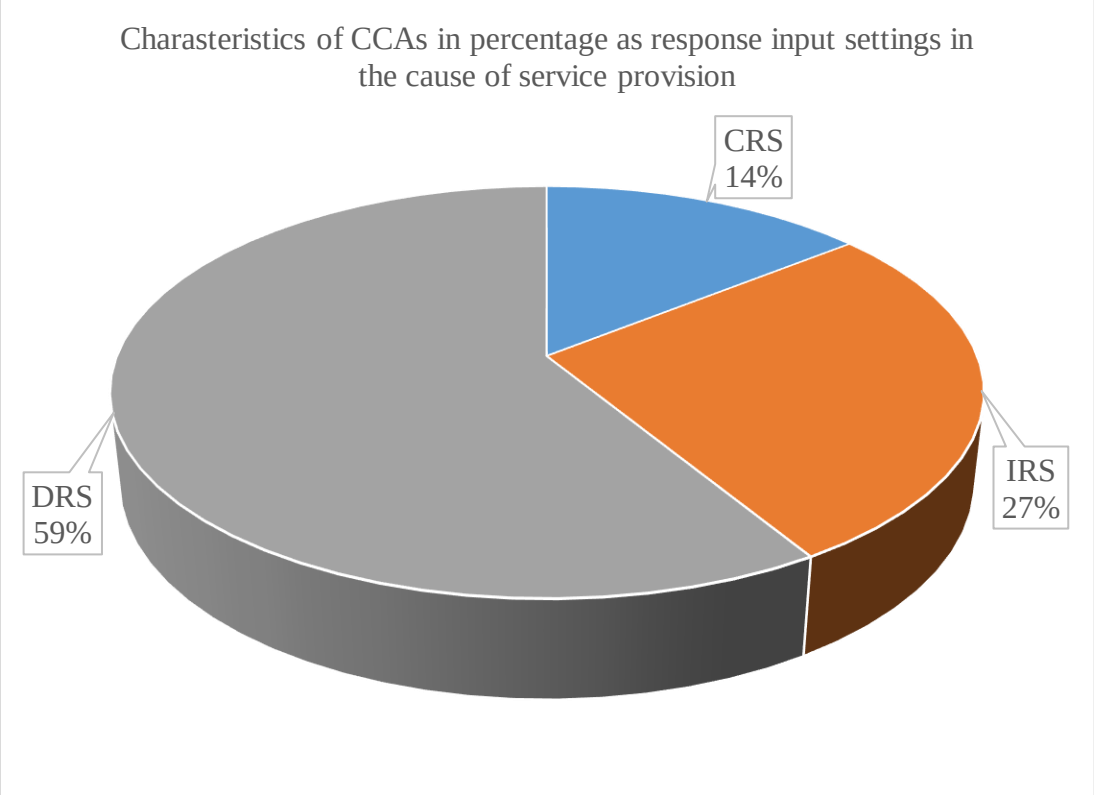

Fig. 4.8: Characteristics of CCAs in Percentage as Response to Input Setting In the Cause of Service Provision

4.4.4 CCAs Technical Efficiency under VRS and Its Implications

In both analyses of DEA-CCR (which assumes a constant return to scale) and DEA- BCC (which assumes a variable return to scale). The ability to employ the same level of inputs and produce the same or greater outcomes distinguishes decision-making units that were considered efficient (Coelli, 1996; Cooper et al., 2011). Furthermore, the efficiency of all decision-making units was tested under the assumption that all observations fall on or below the extreme frontier (Cooper et al., 2011).

It had been found that 12 CCAs or 19% of the sampled CCAs were technically efficient under VRS. Tahir et al., (2009) argued that a firm that is efficient under VRS was considered technologically efficient; the VRS score represents pure technical efficiency (PT), whereas a firm that is efficient under CRS was technologically efficient and also uses the most efficient scale of operation. Scale efficiency (S) was derived from the measures of technical efficiency (T) and pure technical efficiency (PT).

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Additionally, 42 CCAs or 67% of the 63 sampled CCAs were neither found technically efficient under CRS nor they were technically efficient under VRS. Theseresults implied that more than half of the 63 sampled CCAs were not technically efficient and therefore impacting negatively the efficiency of Tanzania on Logistics Performance Index. This goes further more specifically implying that the component of Logistics quality and competence was inefficient due to inefficient customs Clearance agents (Figure 4-9).

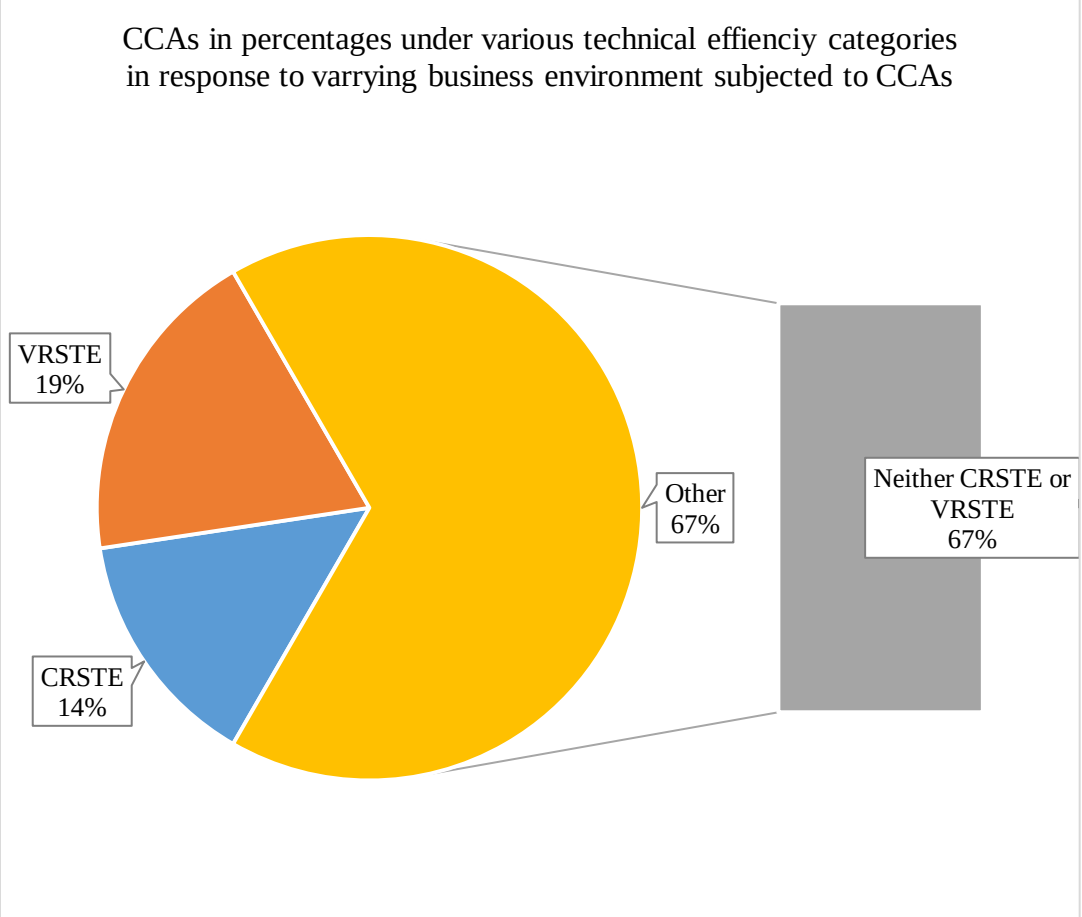

Fig. 4.9: CCAs in Percentage under Various Technical Efficiency Categories in Response to Varying Business Environment Subjected to CCAs

That is, 14% of the 63 sampled CCAs were efficient under CRS which implied that they were technologically efficient and also uses the most efficient scale of operation to provide cargo Clearance services in Dar es Salaam Port. Furthermore, 19% of the 63 sampled CCAs were considered technologically efficient under VRS; the VRS score represents pure technical efficiency (PT).

4.4.5The Contribution of Resource Inputs to CCAs Technical Efficiency

The conceptual framework of this study identified five measurable resource inputs which were necessary to contribute to the technical efficiency of the CCAs in offering cargo Clearance services at Dar es Salaam Port. These were, office space in square meters, number of staff employed by the CCA, number of staff with professional training in (logistics/Shipping), number of computers owned by the CCA and number of computers connected to Cargo Clearance networks (TANCIS, Cargo Systems).

Pattanamekar et al., (2011) argued that each shipping firm decides on its strategy as a Decision Making Unit (DMU) without taking into account the strategies of other companies. Because of firm confidentiality, tracking a productivity process for each unit in a competitive market was viewed as a black box. The optimal utilization of each available resource was dependent on the decision of individual CCA for optimal service output provision. The technical efficiency of CCA was dependent on the optimal utilization of available

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input resources. The research developed specific objectives that called for data search on the identified parameters so that to respond to the research questions. The parameters measurement were the input resources required to analyze the technical efficiency of the CCAs together with the efficient utilization of each input towards the desired technical efficiency of the CCA. Data analysis was geared to find the answer for specific study objectives and respond to the research questions:

First, examining the effects of Office Space (in sq. meters) on technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port;

Second, examining the role of Staff qualifications on technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port.

Third, assessing the effects of ICT equipment on the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port. The results from the analysis were clearly presented in the following paragraphs.

4.4.5.1 Overall Inputs Contribution to CCAs Technical Efficiency

Overall, the data revealed that 62 % of the selected CCAs had optimally utilized all indicated inputs, resulting in positive contribution technical efficiency of the CCAs and thus, optimal cargo Clearance services. This meant that out of the 63 sampled CCAs, an average of 39 CCAs allocated the indicated resource inputs to produce optimal service output. Furthermore, the study found that an average of 38% of the CCAs investigated did not make optimal use of available input resources to achieve optimal output in the provision of cargo Clearance services. This was equated to an average of 24 CCAs.

The results implied that an average of 38% of the sampled CCAs would need to carry input adjustment of some kind so that to achieve their optimal output service provision. The total average input adjustment required for achieving optimal input resource requirement were 4.631 square meters for Offices spaces, an average of 1.08 number of staff employed by a CCA, an average of 0.744 number of staff with training in (logistics/shipping), an average of 0.738 number of computers owned by CCA and an average of 0.512 number of computer networked to cargo Clearance systems such as TANCIS and Cargo System.Figure 4-10 and Appendix III of this study summarized results and mean slacks for each input available in the provision of cargo Clearance services for the studied CCAs.

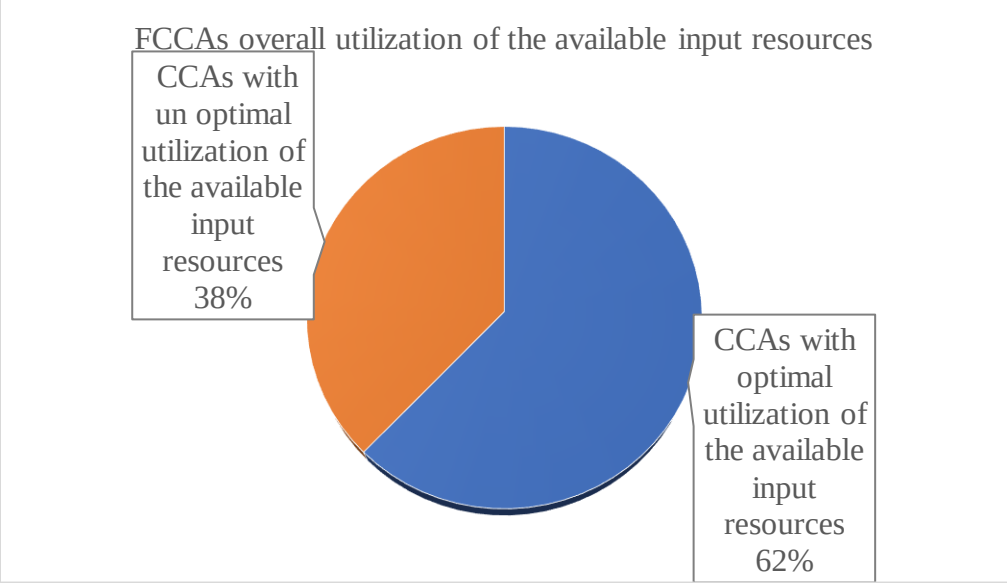

Fig. 4.10: CCAs in Percentage under Various Technical Efficiency Categories in Response to Varying Business Environment Subjected to CCAs

The specific results for each input resource to the specific CCAtechnical efficiency were summarized depending on specific study objectives as follows.

4.4.5.2Office Space (in square meters) On Technical Efficiency

According to the findings, 51% of the 63 CCAs whose office space was assessed in square meters had a favorable impact on their technical efficiency. This meant that Office space influenced the technical efficiency of 32 CCAs out of the 63 sampled CCAs (in square meters). The data also found that 31 CCAs' equivalent to 49% needed an adjustment of office space in square meters to contribute to CCA's overall technical efficiency. The average Office space required adjustment was 9.41 square meters. This required adjustment entails deducting Office space on an average of 9.41 square meters. The results impliedly meant that the management of the 31 CCAs was not efficient in the utilization of Office space of their company so that it can be meaningful in accelerating the overall CCA technical efficiency of service provision in cargo Clearance through Dar es Salaam Port. Figure 4-11 and appendix Table 4-5 summarized this very clearly. The results implied that it was not generally that office space could had no positive effect on all business entity offering cargo Clearance service from the sampled CCAs.

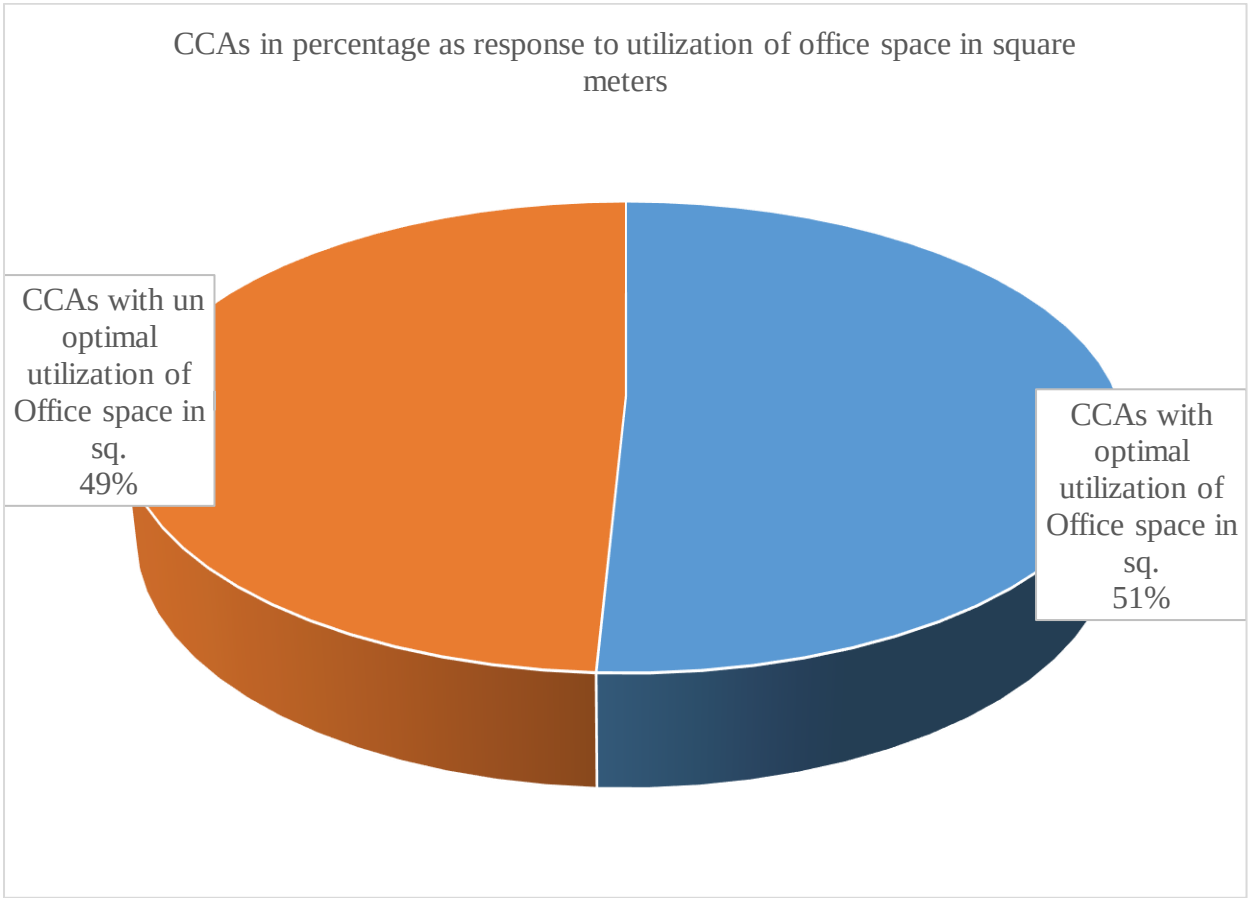

Fig. 4.11: CCAs in Percentage as Response to Utilization of Office Space in square meters

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4.4.5.3 Staff Qualifications on Technical Efficiency

According to the research findings, 63% of the 63 CCAs whose number of staff with professional training in (logistics/shipping) was evaluated had a positive impact on their technical efficiency. This showed that staff with professional training in (logistics/shipping) had an impact on the technical efficiency of 40 CCAs out of the 63 sampled CCAs. Furthermore, it was found that the technical efficiency of 23 CCAs, or 37% were not achieve through professional staff with training in (logistics/shipping), that was, the 23 CCA required resource adjustment in relation to staff with professional training. By examining the analysis results in appendix III it can be noted that the average resource adjustment on staff with professional training on logistics/shipping by reduction was an average of 2 staff so that the 23 CCAs could achieve technical efficiency through the utilization of this resource. The findings suggested that the management of the 23 CCAs were inefficient in utilizing their company's professionally trained staff in such a way that it may be useful in accelerating the overall CCA technical efficiency of cargo Clearance through Dar es Salaam Port. Figure 4-12 provides a brief presentation of the findings.

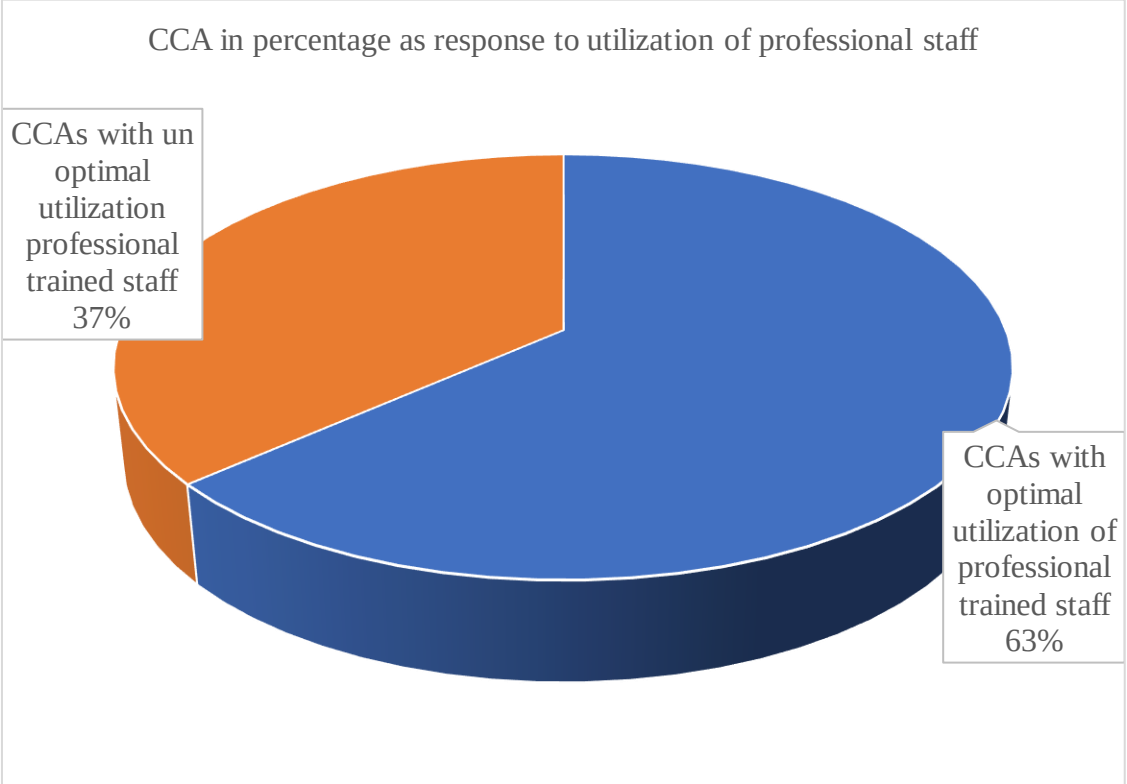

Fig. 4.12: CCAs in Percentage as Response to Utilization of Professional Staff

4.4.5.4ICT Equipment on Technical Efficiency

According to research findings, 62% of the 63 sampled CCAs had computers equipment influence on their technical efficiency. That implied that the efficiency CCAs sampled depended on computer equipment by 62% and the rest of the CCAs required Managerial techniques to manage computer resources for optimal service production. It further implied that the 24 CCAs which was equivalent to 38% technically inefficient on the use of computer equipment and therefore they are required to adjust by reducing at an average of 1.34 or approximately 1 computer equipment so that the management can use the remaining effectively.Figure 4-13 gives a clear presentation of this description together with the original source information appendix III of this report.

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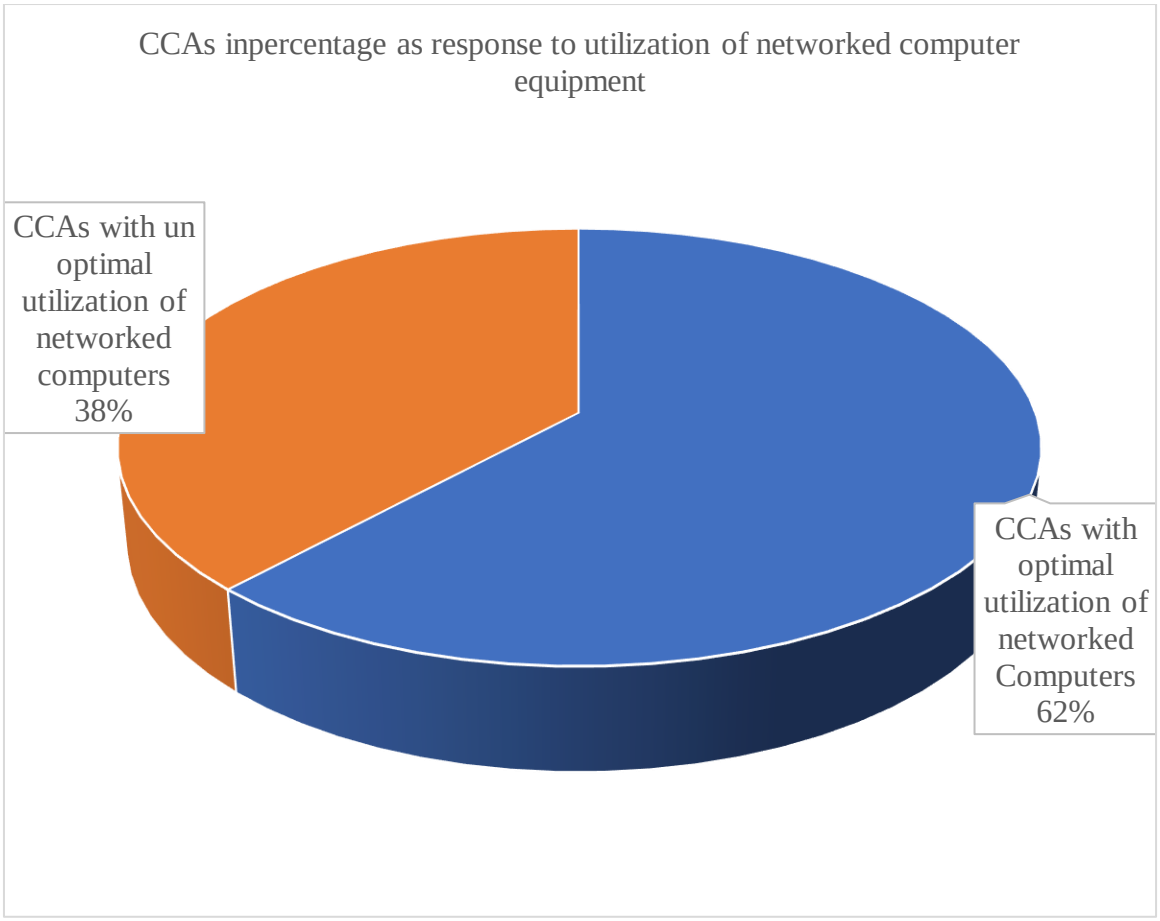

Fig. 4.13: CCAs in Percentage as Response to Utilization of networked Computer Equipment

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CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This dissertation assesses relative efficiencies of the 63 sampled CCAs offering cargo Clearance services at Dar es Salaam Port. The Data Envelopment Analysis (DEA) which was the widely used methodology to assess the relative efficiency of Decision Making Units (DMUs) of which in this case they were CCAs was employed in this study to compare the 63 sampled CCAs at Dar es Salaam Port. Moreover, the DEA was regarded as the very powerful tool that can relate multiple outputs and inputs, establish a ranking and benchmarking, as long as the data were accurate, balanced, and DMUs comparable. Several inputs variables were carefully identified and selected for the analysis. A sample of 63 CCAs from the registered CCAs was systematically randomly selected. The author was able to collect data for the following five (5)-input variables: Office space (in square meters), number of staff employed by the CCA, number of staff with professional training in Logistics/Shipping, number of computers owned by CCA, and number of computers networked with cargo Clearance systems (TANCIS, Cargo Systems etc.). Also, data for one-output variable, namely: cargo volume cleared by CCA (in Metric tons) was collected.

5.2 The Conclusion

The general objective of the study was to assess the technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port with its specific objectives which were to examine the effects of Office Space (in sq. meters), the role of Staff qualifications ICT equipment, and on technical efficiency of CCAs offering cargo Clearance services at Dar es Salaam Port consecutively.

It was from that context the research findings concluded that only 9 CCAs out of the 63 CCAs which were sampled and studied were technically efficient under CRS equivalent to 14% of the studied sample and 54 CCAs out of the 63 sampled CCAs equivalent to 86% were technically inefficient. On the other hand, the research findings concluded that 12 CCAs or 19% of the sampled CCAs were technically efficient under VRS and 42 CCAs or 67% of the 63 sampled CCAs were neither found technically efficient under CRS nor technically efficient under VRS.

Furthermore, 51% of the 63 CCAs whose office space was assessed in square meters had a favorable impact on CCAs technical efficiency. Also, 63% of the 63 CCAs whose number of staff with professional training in(logistics/shipping) was evaluated had a positive impact on CCAs technical efficiency. Lastly, 62% of the 63 sampled CCAs had computers equipment influenced on CCAs technical efficiency.

This showed that CCAs technical efficiency was positively affected by office space (in square meters) at a rate of 51%, staff qualifications at 63% and ICT equipment by 62% regarding to the sample studied during this research.

5.3 Recommendation for Future Studies

This research confined itself at assessing the technical efficiency of customs Clearance agencies (CCAs) offering cargo Clearance services at Dar es Salaam Port. Technical efficiency assesses how efficiently a company utilized the input resources to produce the required output in the economy. Further and detailed studies are necessary in the same area where a sample size of the CCAs to be studied will be increased and increase time period instead of one-year data. Such a study will assess not only the technical efficiency of a CCAs in one year but also will assess efficiency trends of the CCAs over the period of time. Furthermore, more studies on the area may assess the economic efficiency of CCAs where it will look at both allocative and technical efficiency.

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Despite above recommendations, further studies can be done on the same area with the objective of assessing the benchmark of optimal resources required by CCAs in Dar es Salaam to become optimal in service provision.

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APPENDIXES

APPENDIX I: Sample Questionnaire

QUESTIONNAIRE FOR OBTAINING INFORMATION NECESSARY FOR ASSESSING TECHNICAL EFFICIENCY OF CUSTOMS CLEARANCE AGENCIES (CCAS) OFFERING CARGO CLEARANCE SERVICES AT DAR ES SALAAM PORT

CONSENT PREAMBLE FOR SURVEY

Are you conducting a survey?

A. Yes: _____

B. No: _____

You have been asked to complete this survey as part of a research project conducted by, [ANDULILE R. MWAISAKA], a [STUDENT,] at DAR ES SALAAM MARITIME INSTITUTE (DMI), in DAR ES SALAAM. The research project is called [ASSESSING TECHNICAL EFFICIENCY OF CUSTOMS CLEARANCE AGENCIES OFFERING CARGO CLEARANCE SERVICES AT DAR ES SALAAM PORT (CCAs)]. The study is designed to [MEASURE OF TECHNICAL EFFICIENCY OF CFAs AT DAR ES SALAAM PORT]. You are being asked to participate in this because [YOUR COMPANY WAS SELECTED DUE TO ITS KEY ROLE IN CUSTOMS CLEARANCE PROCESSES AT DAR ES SALAAM PORT IN RANDOMLY SELECTION]. Your responses are entirely voluntary, and you may refuse to complete any part or all of this survey. This survey is designed to be anonymous, meaning that there should be no way to connect your responses with you. Toward that end, please do not sign your name to the survey or include any information in your responses that makes it easy to identify you. By completing and submitting the survey, you affirm that you are at least 18 years old and that you give your consent for [ANDULILE R. MWAISAKA] to use your answers in this research. If you have any questions about this research before or after you complete the survey, please contact [ANDULILE R. MWAISAKA and]. If you have any concerns or questions about your rights as a participant in this research, please contact the DAR ES SALAAM MARITIME INSTITUTE DMI REVIEW BOARD.

QUESTIONNAIRE

Input/ Output Resources	**A measure in the Year 2020**
Office Space in square meters	
Number of staff employed by the CCA	
Number of staff with professional training in (logistics/Shipping)	
Number of computers owned by the CCA	
Number of computer connected to Cargo Clearance networks (TANCIS, Cargo System etc.)	
Cargo Volume (in Tons)	

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APPENDIX II: Data Findings from The 63 Sampled CCAs Before Analysis

CCA Firm	INPUTS					OUTPUT	CCA Firm	INPUTS					OUTPUT
	Office Space	Number of Employees	Number of Staff with professional trainings (logistics/Shipping)	Number of Computers owned by CCAs	Number of Computer connected to Cargo Clearing Networks	Volume of Cargo (Metric Tonnes)		Office Space	Number of Employees	Number of Staff with professional trainings (logistics/Shipping)	Number of Computers owned by CCAs	Number of Computer connected to Cargo Clearing Networks	Volume of Cargo (Metric Tonnes)
CCA1	120	50	5	19	12	65,000	CCA31	80	28	8	10	10	42,800
CCA2	120	53	-	18	11	60,000	CCA32	35	14	3	9	9	35,200
CCA3	115	40	15	14	12	55,300	CCA33	40	15	5	7	7	26,300
CCA4	119	22	10	14	14	37,000	CCA34	50	23	5	12	12	70,000
CCA5	120	45	16	20	15	62,800	CCA35	65	26	8	10	10	48,200
CCA6	50	12	4	8	6	45,300	CCA36	35	12	9	6	6	19,000
CCA7	75	18	10	9	9	52,300	CCA37	57	20	5	10	10	45,700
CCA8	100	45	30	25	25	70,000	CCA38	53	21	8	12	10	50,100
CCA9	115	51	25	25	15	85,000	CCA39	60	24	5	10	10	45,250
CCA10	50	15	5	13	13	45,700	CCA40	60	25	9	6	6	25,600
CCA11	30	10	4	9	8	35,000	CCA41	58	12	3	11	10	52,400
CCA12	85	39	19	10	10	60,000	CCA42	60	25	13	10	10	63,200
CCA13	110	50	11	20	15	70,000	CCA43	45	16	2	8	8	28,920
CCA14	45	19	8	10	10	56,700	CCA44	69	20	5	10	10	54,430
CCA15	50	20	5	12	12	45,000	CCA45	40	15	2	10	10	38,250
CCA16	69	25	11	15	12	58,000	CCA46	25	10	4	5	5	38,000
CCA17	100	45	15	12	12	65,000	CCA47	64	25	10	12	12	45,450
CCA18	58	19	5	10	10	57,500	CCA48	40	15	5	7	7	49,000
CCA19	90	40	12	20	20	80,000	CCA49	105	50	12	15	15	70,000
CCA20	30	9	6	4	4	25,000	CCA50	115	53	16	12	12	67,850
CCA21	45	15	5	7	7	35,000	CCA51	64	30	10	10	10	68,000
CCA22	50	20	5	8	8	45,000	CCA52	55	21	2	11	10	34,700
CCA23	115	46	15	10	10	69,000	CCA53	45	20	4	5	5	45,200
CCA24	85	35	10	12	12	54,500	CCA54	47	19	5	11	11	54,000
CCA25	100	40	4	17	17	58,900	CCA55	125	52	10	15	10	67,320
CCA26	45	15	5	7	7	38,000	CCA56	90	40	5	12	12	54,950
CCA27	45	16	4	8	8	25,800	CCA57	25	10	2	4	4	30,000
CCA28	80	35	15	10	10	85,000	CCA58	112	50	10	15	15	65,700
CCA29	50	20	8	9	9	32,600	CCA59	35	10	3	5	5	15,000
CCA30	75	25	7	10	10	59,600	CCA60	60	25	10	10	10	45,000
							CCA61	32	15	4	8	8	32,650
							CCA62	25	6	2	3	3	10,000
							CCA63	40	8	4	8	8	35,400

Source: Questionnaires and interview findings

APPENDIX III: Data Analysis Results of Efficient and Inefficient CCAs fromthe 63 Sampled.

SUMMARY OF INPUT UNITS CONTRIBUTING TO INEFFICIENCY OF THE 63 SAMPLED CCAs OFFERING CARGO CLEARING SERVICES IN TANZANIA											
Firm	Office Space (sq.meters)	Number of Employees	Number of Staff with proffesional trainings (logistics/Shipping)	Number of Computers owned by CCAs	Number of Computer connected to Cargo Clearing Networks	CCA Firm	Office Space (sq.meters)	Number of Employees	Number of Staff with proffesional trainings (logistics/Shipping)	Number of Computers owned by CCAs	Number of Computer connected to Cargo
CCA 1	5.849	0.000	0.000	1.942	0.000	CCA 34	0.000	0.000	0.000	0.000	0.000
CCA 2	0.000	0.000	0.000	0.000	0.000	CCA 35	0.235	0.000	0.000	0.000	0.000
CCA 3	7.364	0.000	1.369	0.573	0.000	CCA 36	0.000	1.286	3.786	0.643	0.643
CCA 4	20.738	0.000	0.257	0.000	0.000	CCA 37	6.132	0.000	0.000	0.000	0.042
CCA 5	2.128	0.000	0.000	1.978	0.000	CCA 38	0.000	0.000	0.812	1.171	0.000
CCA 6	0.000	0.000	0.000	0.000	0.000	CCA 39	3.277	0.000	0.000	0.000	0.000
CCA 7	19.203	0.000	2.818	0.000	0.313	CCA 40	12.800	6.630	3.670	0.000	0.000
CCA 8	1.111	0.000	10.333	0.778	0.778	CCA 41	0.000	0.000	0.000	0.000	0.000
CCA 9	0.000	0.478	2.391	7.391	0.435	CCA 42	0.000	0.000	3.363	0.000	0.077
CCA 10	0.000	0.000	0.197	2.413	2.782	CCA 43	3.580	0.000	0.000	1.650	2.471
CCA 11	0.000	0.000	0.000	3.002	2.070	CCA 44	20.553	0.000	0.000	0.000	0.000
CCA 12	0.289	1.173	4.942	0.000	0.000	CCA 45	0.000	0.000	0.000	0.000	0.000
CCA 13	0.000	0.782	0.000	1.954	0.000	CCA 46	0.000	0.000	0.000	0.000	0.000
CCA 14	0.000	0.000	2.693	0.000	0.065	CCA 47	0.000	0.000	0.343	0.000	0.071
CCA 15	0.000	0.000	0.000	1.243	1.318	CCA 48	0.000	0.000	0.000	0.000	0.000
CCA 16	0.000	0.000	2.739	1.338	0.000	CCA 49	11.415	7.096	0.000	0.000	0.000
CCA 17	0.502	0.836	0.000	0.000	0.000	CCA 50	10.267	6.114	0.201	0.000	0.000
CCA 18	12.351	0.000	0.000	0.000	0.063	CCA 51	0.000	1.642	0.000	0.000	0.000
CCA 19	17.500	7.889	0.000	8.778	8.778	CCA 52	3.983	0.000	0.000	2.689	3.077
CCA 20	3.983	0.000	3.415	0.000	0.000	CCA 53	0.000	0.000	0.000	0.000	0.000
CCA 21	4.851	0.000	0.005	0.000	0.000	CCA 54	0.000	0.000	0.000	0.550	0.658
CCA 22	2.927	0.000	0.000	0.000	0.000	CCA 55	30.832	10.989	0.000	2.948	0.000
CCA 23	25.955	7.784	1.407	0.000	0.000	CCA 56	10.352	4.407	0.000	0.000	0.984
CCA 24	1.663	0.000	0.000	0.000	0.000	CCA 57	0.000	0.000	0.000	0.000	0.000
CCA 25	5.685	0.000	0.000	0.000	2.106	CCA 58	18.577	8.072	0.000	0.000	0.000
CCA 26	5.957	0.000	0.000	0.000	0.000	CCA 59	0.000	0.207	0.062	0.297	0.297
CCA 27	0.000	0.000	0.000	0.578	0.578	CCA 60	0.000	0.000	0.179	0.000	0.000
CCA 28	0.000	0.000	0.000	0.000	0.000	CCA 61	0.000	1.721	0.459	1.918	1.918
CCA 29	0.000	0.212	1.085	0.095	0.095	CCA 62	0.000	0.000	0.000	0.000	0.000
CCA 30	14.660	0.000	0.000	0.000	0.000	CCA 63	0.000	0.000	0.000	0.000	0.000
CCA 31	7.052	0.000	0.000	0.000	0.000						
CCA 32	0.000	0.000	0.000	2.254	2.282	**Mean**	**4.638**	**1.08**	**0.744**	**0.738**	**0.512**
CCA 33	0.000	0.717	0.373	0.334	0.334						

Source: DEAP Version 2.1 analysis

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Appendix IV: A Summary Results of Technical Efficiency, Variable Return to Scale Efficiency and Scale Efficiency Estimates from 63 Sample of CCAs

EFFICIENCY SUMMARY FOR A SAMPLE OF 63 CCAs OFFERING CARGO CLEARANCE SERVICES IN TANZANIA									
Firm	**CRSTE**	**VRSTE**	**SCALE**	**RTS**	**Firm**	**CRSTE**	**VRSTE**	**SCALE**	**RTS**
CCA1	0.742	0.853	0.870	drs	CCA33	**0.496**	**0.625**	**0.794**	**irs**
CCA2	1.000	1.000	1.000	-	CCA34	1.000	1.000	1.000	-
CCA3	0.538	0.544	0.99	drs	CCA35	0.600	0.635	0.945	drs
CCA4	0.422	0.424	0.994	irs	CCA36	0.417	0.714	0.583	irs
CCA5	0.503	0.523	0.962	drs	CCA37	0.677	0.708	0.956	drs
CCA6	1.000	1.000	1.000	-	CCA38	0.653	0.722	0.904	drs
CCA7	0.765	0.880	0.869	drs	CCA39	0.620	0.664	0.933	drs
CCA8	0.461	0.511	0.901	drs	CCA40	0.472	0.630	0.749	irs'
CCA9	0.662	0.696	0.952	drs	CCA41	1.000	1.000	1.000	-
CCA10	0.770	0.781	0.986	drs	CCA42	0.794	0.883	0.899	drs
CCA11	0.892	0.932	0.957	irs	CCA43	0.732	0.883	0.829	irs
CCA12	0.677	0.686	0.987	drs	CCA44	0.806	0.863	0.934	drs
CCA13	0.561	0.676	0.83	drs	CCA45	1.000	1.000	1.000	-
CCA14	0.829	0.918	0.903	drs	CCA46	1.000	1.000	1.000	-
CCA15	0.682	0.689	0.989	irs	CCA47	0.494	0.531	0.932	drs
CCA16	0.631	0.727	0.868	drs	CCA48	0.925	1.000	0.925	drs
CCA17	0.616	0.627	0.981	drs	CCA49	0.561	0.667	0.841	drs
CCA18	0.87	0.936	0.93	drs	CCA50	0.625	0.654	0.957	drs
CCA19	0.606	0.972	0.623	drs	CCA51	0.839	0.907	0.925	drs
CCA20	0.803	0.966	0.832	irs	CCA52	0.768	0.827	0.93	irs
CCA21	0.66	0.663	0.995	irs	CCA53	1.000	1.000	1.000	-
CCA22	0.731	0.773	0.946	drs	CCA54	0.853	0.854	0.999	irs
CCA23	0.763	0.799	0.955	drs	CCA55	0.745	0.857	0.869	drs
CCA24	0.55	0.591	0.93	drs	CCA56	0.673	0.749	0.898	drs
CCA25	0.694	0.721	0.962	drs	CCA57	1.000	1.000	1.000	-
CCA26	0.717	0.728	0.985	drs	CCA58	0.531	0.647	0.822	drs
CCA27	0.479	0.56	0.857	irs	CCA59	0.426	0.714	0.597	irs
CCA28	0.979	1.000	0.979	drs	CCA60	0.565	0.568	0.995	drs
CCA29	0.467	0.500	0.934	irs	CCA61	0.704	0.781	0.901	irs
CCA30	0.763	0.856	0.892	drs	CCA62	0.461	1.000	0.461	irs
CCA31	0.523	0.532	0.985	drs	CCA63	1.000	1.000	1.000	-
CCA32	0.799	0.815	0.98	irs					
	CRSTE	**VRSTE**	**SCALE**						
MEAN	0.708	0.777	0.911						

Source: DEAP Version 2.1 analysis

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APPENDIX V: Comments and Observations from the Panellist

RESEARCH TITLE *"AN ASSESSMENT OF TECHNICAL EFFICICNCY OF CUSTOMS CLEARANCE AGENCIES (CCAs) OFFERING CARGO CLEARANCE SERVICES AT DAR ES SALAAM PORT"*

DMI BOARD ROOM ON 30TH OF NOVEMBER 2021

Sn	Panellist Observation	The Correction Made	Page Number
1	Abstract	Adjusted the indent and replaced "by" by "to" and "number of" by "some"	i
2	Certification	Adjusted the left "indent space" and deleted "a"	ii
3	Copyright	Adjusted the left "indent space" and replaced "in" by "on'	iii
4	Declaration	Adjusted the left "indent space" and added "s" to "award"	iv
5	Dedication	Adjusted the left "indent space"	v
6	Acknowledgement	Adjusted the left "indent space"	vi
7	Table of Content	Removed "bold" content and changed the font to "Times New Roman"	viii
8	List of acronyms	Adjusted the top "indent space"	x
9	List of tables	Table 3-2 added "to" on the table title	xii
10	List of figures	Changed the capitalized word "CLEARANCE" to "Clearance" and corrected typing errors on the word "Characteris-"to the word "characteristics". The entire list of figures	xiii
11	Figures presentation are not clearly presented	All figures presentation was reviewed to reflect comments from the Panellist. Font type were changed to "Times New Roman" to all figures. Figure title font revised to 12 size as per guidance given on 6th December 2021	26-52 29, 40, 41, 42,
12	Research Design	Was improved as per DMI Panellist	23
13	Chapter One: Introduction	Improved grammatical error of the entire chapter as per External supervisor and DMI Panellist on verbal and in written form from the eight (8) Dissertation Report which was distributed to the Panellist members.	1-6
14	The findings does not describe the research objectives	Findings have been aligned with the research objectives	33-54
15	How space has effects to the findings	All findings has responded to the research specific objectives	33-52 and 53-54
16	Validity and reliability of research instruments	Clarity has been given about the validity and reliability of research instruments	32
17	Chapter Two: Literature Review	Improved grammatical error of the entire chapter as per External supervisor and DMI Panellist on verbal and in written form from the eight (8) Dissertation Report which was distributed to the Panellist members	7-22
18	Chapter three: Research Methodology	Improved grammatical error of the entire chapter as per External supervisor and DMI Panellist on verbal	23-33

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		and in written form from the eight (8) Dissertation Report which was distributed to the Panellist members.	
19	Chapter Four " Data Analysis, Findings and Discussion"	Improved grammatical error of the entire chapter as per External supervisor and DMI Panellist on verbal and in written form from the eight (8) Dissertation Report which was distributed to the Panellist members.	33-53
20	Chapter Five	Improved grammatical error of the entire chapter as per External supervisor and DMI Panellist on verbal and in written form from the eight (8) Dissertation Report which was distributed to the Panellist members.	53-54
21	Reference	Was improved by numbering them as per DMI guidelines and rearranged in alphabetical order as per DMI Panellist. Furthermore, the missing authors where added to the list accordingly. Rearrangement in has been done as per guidelines given on 06th December 2021	55-62
22	Data Envelopment Analysis	Was revised and the acronym DEA was used instead	10, 16, 20, 47 48 & 51