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Technical Efficiency of Container Terminal Operations in Southwestern Seaport in Nigeria

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ABSTRACT: *Containerization plays a crucial role in international trade. It promotes the oceanic business, generally pertinent to container terminals. Despite the various benefits of the container terminal to maritime trade and the economic development of nations with seaports, Nigerian ports are suffering from a progressive decline compared to other thriving ports in other parts of the globe. Hence, this study evaluates the technical efficiency of container terminal operations in southwestern seaport in Nigeria. Survey research design was adopted for this study in which Multi-stage sampling technique was used. Both primary and secondary data were collected from the annual report and questionnaire respectively from staff of the container terminal operators in Tincan Island Port Complex and Apapa Port Complex. The result from the findings showed that four factors influenced container terminal capacity and port performance. These include port charges, stevedoring operations, unserviceable cranes and ship calls. Also, the Data Envelopment Analysis (DEA) findings showed that AP Moller Terminal, PCHS, and PTML have a crste, vrste, and scale efficiency of 1, indicating they are fully technically efficient under both constant and variable returns to scale. It was concluded that AP Moller Terminal, PCHS and PTML are the most efficient terminal in South-Western Ports in Nigeria. It was recommended that periodic training and retraining of staff handling modern equipment should be prioritized and also, increase in port charges by the terminal operators should be addressed to encourage freight forwarders to clear their cargo on time at the port.*
KEYWORD: Technical efficiency, container terminal, containerization, operators, seaport, Data Envelopment Analysis (DEA**)**

INTRODUCTION

Containerization plays a crucial role in international trade. It promotes the oceanic business, generally pertinent to container terminals. Bandeira et al. (2009). The containers are big, standard boxes. Malcolm McLean, an American business visionary, came up with them in 1956. Cudahy, (2006). They are the best way for goods to move around in the history of sea trade. Container terminals should be fabricated and utilized alongside billets and cranes that are sufficiently incredible to deal with container ships. Also, container terminals are needed to put resources into ride transporters, farm haulers, and trailers to move containers from berthing offices to the yard and yard to the door and the other way around. Arrange adequate storage spaces to facilitate impermanent container stockpiling to work with import, fare, and transshipment techniques. These are only a few instances of the base required offices with the legitimate ability to move containers starting with one port and then onto the next.

Containerization has enhanced optimum advantages of through-movement of freights. Apart from cost minimization, the introduction of containerization has lowered time expended in transferring freight from manufacturer to consumer, as well as time spent in storage yard (Lingaitienė, 2008; Pocklad. 2007; Kazakov, 2006; Kolos, 2006). Efficiency created by container innovation has created an ambience of competition in the port industry. Thus, ports, especially container terminals are been challenged to adjust throughput capacity to meet demand by investing adequately in state-of-the-art cargo handling and other terminal infrastructure for container ports. Thus, the introduction of containerization into maritime industry has been considered as revolutionary as completely new ways of doing business have emerged. For instance, containerization has created a completely new means of freight distribution especially the facilitation of a shift from push logistics to pull logistics.

Despite the various objectives and benefits of the container terminal to maritime trade and the economic development of nations with seaports, Nigerian ports are suffering from a progressive decline in significance, especially compared to other thriving ports in other parts of the globe. The decline in significance in Nigerian seaports is traceable to low investment in cargo handling infrastructure, long turnaround time of ships at ports, cargo dwell time, and its attendance port area congestion Nigerian Ports. Park et al. (2014) asserted that there are a lot of insufficiencies to measure the port capacity due to the sheer number of parameters involved; the lack of up-to-date, factual and reliable data which are collected in an accepted manner and available for publication or divulgation, the absence of generally agreed and acceptable definitions, the profound influence of local factors on the data obtained, and the divergent interpretations given by various interests to identical results. This research was carried out to fill the gap by evaluating the technical efficiency of container terminal operations in southwestern seaport in Nigeria.

LITERATURE REVIEW

Container Terminals

Decision problems at container terminals are comprehensively described by Vis and de Koster, (2003). An overview of relevant literature for problem classes like arrival of the ship, offloading of a ship, from stack, stacking of containers, inter-terminal transport and complete terminals is provided. Figure 1 provides a diagrammatic representation of an open system of a container terminal to further the interface.

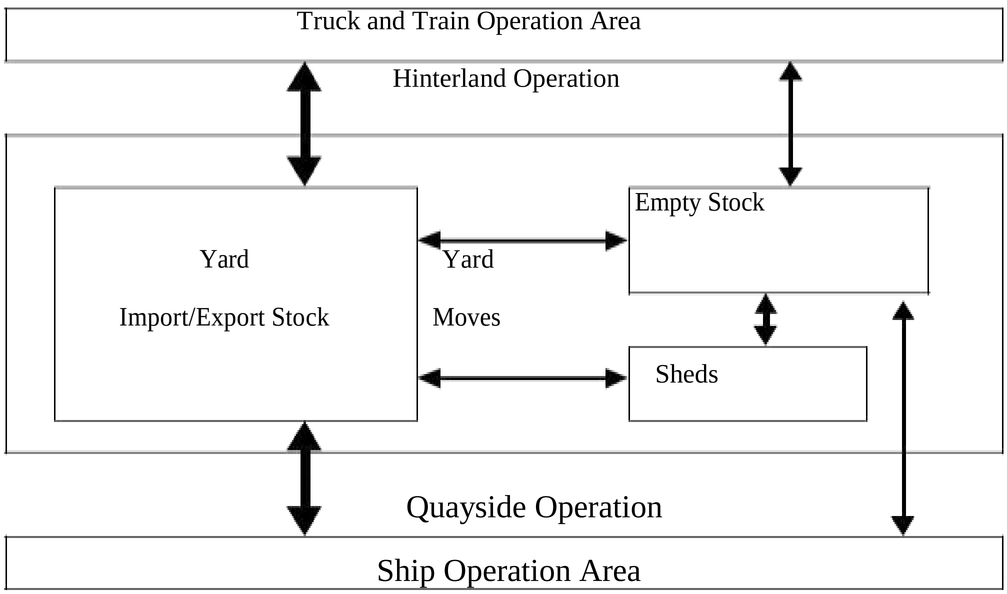

Figure 1: Open system of a container terminal
Source: Dirk *et al.* (2004)

Containers

Containers are large boxes that are used to transport goods from one destination to another. Compared to conventional bulk, the use of containers has several advantages, namely less product packaging, less damaging and higher productivity Agerschou et al. (1983). The dimensions of containers have been standardised. The term twenty-feet-equivalent-unit (TEU) is used to refer to one container with a length of twenty feet. A container of 40 feet is expressed by 2 (TEU) twenty-feet-equivalent-unit.

The dimensions of most common containers are shown in Fig. 2. These specifications are based on recommendations by the International Standardization Organization. The containers have specially built corner fittings which enable the material handling equipment to pick them up from the top or from the side.

Length - 20 feet or 40 feet, Height 8 feet or 8.5 feet, Width 8 feet.

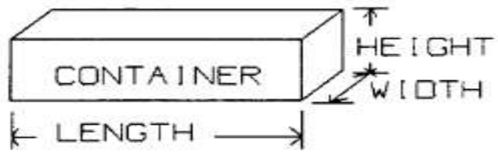

Fig. 2: Container dimensions
Source: Agerschou et al. (1983).

Container Terminal Facility
A variety of material handling facility is used in container port operation. Following is a brief description of the material handling equipment being used at Port.

Gantry crane or transtainer (Fig. 3). This equipment has a 50-ton capacity and rubber wheels. Due to its heavy weight, it runs on a special concrete path. Wheels will turn 90 degrees to change direction during section changes. Normally, a transtainer is scheduled not to move between sections except when absolutely necessary. The beam spans over several stacks and the spreader bar moves down to reach a specific container. It can stack containers four high. It cannot reach the bottom container until the upper containers have been removed (McDowell E., Cho, D., & Martin, 1985)

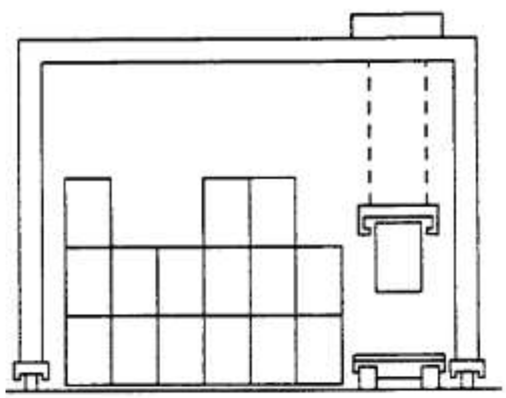

Fig 3: Gantry crane or transtainer.
Source: McDowell et al. (1985).

Ship crane. The ship crane is electric-powered and has a 50-ton capacity. It can run on rails along the length of the dock. Ship cranes should be kept at least 50 ft apart when more than one crane is working at the same time in order to prevent crane interference.

Trucks and chassis. These are used to carry containers from the transtainer to the ship crane. They are specially designed for container port operations. Chassis may be adjusted to handle either two 20-fi or one 40-ft container. The trucks have special connections for chassis; they raise the chassis and travel with them without having to adjust the landing wheels. In general, three to four trucks are assigned to one transtainer-crane.

Container yard

The container yard, located next to the dock, stores the outbound containers while waiting for a ship and the inbound containers until they are picked up by road trucks. Containers are stored in the yard in a block formation, called the section. In the yard, the cargo is arranged by ship and voyage number. Furthermore, cargo is segregated by weight and commodities, if possible. If there are a large number of containers for the same voyage, an attempt is made not to place cargo for the same voyage in one spot. This is to ensure that two or more transtainers can work on these containers at the same time without interference (Boysen et al., 2017).

Global port/terminal operators (GPOs)

To reduce cost and improve efficiency, shippers would seek carriers to provide efficient and cost effective services, while carriers would seek cost reduction and operation efficiency at the ports they use Mangan et al. (2008). According to a report by Drewry (2010), Hutchison Port Holdings (HPH), APM Terminal, PSA, DP World, China Ocean Shipping Company (COSCO), Eurogate, Evergreen, NYKLINE, SSAMARINE and P&O are the leading port operators worldwide. The smaller terminal operators cannot compete against the major players but concentrate on niche markets.

In order to respond to the concentration trend of shipping lines, the terminal operators have been seeking scale increase. A number of global port operators (GPOs) and international terminal operators (ITOs) have emerged that increasingly control and manage a number of ports worldwide. For example, P&O ports have joined Hutchison, PSA in Singapore and APM Terminals. A.P. Moller - Maersk Group (Copenhagen) operates 50 terminals worldwide as explained earlier. Dubai Ports World (DPW) was created by a merger between the Dubai Ports Authority (DPA) and an international business, DPI Terminals. In 2006, DPW purchased P&O of UK, which was then the fourth largest ports operator in the world. DPW operate 19 major ports worldwide. Hutchison Whampoa‘s subsidiary Hutchison Port Holdings operates in five of the seven busiest container ports in the world, handling 13% of the world‘s container traffic (www.hph.com). Hutchison owns and manages terminals in Shanghai, Xiamen and Yantian. The Port of Singapore Authorities (PSA) owns and manages ports and terminals in other countries. Global terminal operators clearly have shifted their mindset from a local port level to a port network level. In this sense, ports are no longer perceived as non-moveable assets Bichou and Gray (2005).

The top ten (10) container ports ranking in 2009 by AAPA shows that 70% of the top 10 container ports by tonnage are from China. Among the 10 ports, only Rotterdam is outside Asia. In terms of container TEUs, 8 out of the top 10 container ports are from Asia and 6 out of the top 10 ports are from China. The increasing trend in both tonnage volume and TEU throughput increase in the past 20 years shows that Asian, especially China‘s freight, accounts for a large share. The ranking positions are also evidence that the dominant international trade is with Asia and China. This explains why GPOs concentrate their investment in China. The increasing global scale of operations, the large port operators are in a position of potential market domination, which may affect free choice and reduce competition. Souza et al. (2003). Other major regional port operators, such as ABP in UK (United Kingdom) and Dubai Port Authorities in the UAE (United Arab Emmirate), have also expanded their activities internationally with considerable specialisation and international expertise in container terminal management and development.

It should also be noted that not all terminal operators are integrated by M&A. Effective network integration can be realised through better coordination with 3PL or other logistics service providers. The literature has paid much attention to vertical and horizontal integration including ports in the logistics chain, but it overlooks integration of the various activities in the port organisation itself Bichou and Gray, (2004). This is mainly due to the complex organisational structure and management of ports, which has always been a central issue of port management and a major obstacle to the development of a comprehensive conceptual framework of port management.

Data Envelopment Analysis (DEA)

The literature shows that different methods are used for benchmarking, i.e. cross-sectionally comparing, operations. Most companies use ratio indicators; see (de Toni and Tonchia 2001), (de Koster and Warffemius 2005), for overviews of performance measurement and comparison methods in production and warehouse environments, respectively. Container terminal operators use for example container output per hectare of land used. The problem with such partial indicators is that they cannot measure overall technological efficiency. Non-parametric methods, such as DEA, measure technological efficiency by relating multiple inputs to multiple outputs. With other approaches, such as the stochastic frontier approach (SFA), it is possible to measure economic efficiency, which is a broader concept than technological efficiency, as it covers the unit’s reactions to market prices. Economic efficiency includes technical efficiency and allocative efficiency.

A basic assumption of DEA is that, during the time period considered, all DMU shave access to the same technology. Such a technology is defined as the set of all feasible combinations of input quantities and output quantities; that is, all those combinations of input quantities and output quantities such that the output quantities are producible from the input quantities.

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Data Envelopment Analysis Application for Benchmarking container Terminals

Many researchers have used DEA for benchmarking container terminals. (Martinez-Budria et al. 1999) compared the performance of 26 Spanish ports. Song et al. (2003) applied DEA to container terminals in Korea and the UK. In subsequent papers (Wang et al. 2003) and (Cullinane et al. 2005) considered a broad range of DEA variants. They compared results from DEA-CRS, DEA-VRS, and FDH models. (Lin and Tseng 2005) compared DEA results with SFA results on 27 container ports.

In a recent publication (Wang and Cullinane 2006) performed an analysis of 104 container terminals in Europe. They stressed that: it is extremely important to note that although the results derived from DEA provide important information on "theoretically" optimum production, such results should always be interpreted with a fair degree of caution in practice.

DEA has been used widely for benchmarking DMUs, varying from university libraries (Reichmann and Sommersguter-Reichmann 2006) to nursing homes (Duffy et al. 2006), third-party logistics providers (Min and Joo 2006), airports (Graham 2005), and warehouses (de Koster and Balk 2008).

METHODOLOGY

Survey research design was adopted for this study. Both primary and secondary data were collected from the annual report and staff of the container terminal operators in Tincan Island Port Complex and Apapa Port Complex. The study adopts Multi-stage sampling technique in which terminal operators were stratified based on location (Apapa and Tincan Island Ports). The eight terminal operators were purposively selected among others and random sampling was used to select respondents using Yamane's formula. Table 1 shows the sample size of the study. Descriptive statistics was used to analyse factors influencing container terminal capacity and port performance. Data Envelopment Analysis (DEA) was used to determine the efficiency of container terminals

Table 1: Determination of sample size

S/N	TERMINAL	Population	Sample size
1	ENL Consortium Ltd	1098	89
2	AP Moller Terminal	1196	97
3	Greenview Development Nigeria Ltd	500	41
4	Josepdam	61	5
5	PTML	499	41
6	TICT	400	33
7	Port & Cargo Handling Services	408	33
8	Five Star	346	28
	TOTAL	**4508**	**367**

Source: Author's Compilation (2022)

Mathematical formulation of Data Envelopment Analysis

The basic mathematical formulation of DEA has the following form:
Suppose n decision-making units (DMUs), where every DMUj, j = 1, 2,... ., n, produces the same s outputs in possibly different amounts, yrj(r = 1, 2,. . ., s), using the same m inputs, xij(i = 1, 2,. . .m), also in possibly different amounts, while u and v are weights that are assigned, respectively, to the outputs and inputs obtained when solving the model. The Basic mathematical formulation of DEA has the accompany structure.

$$E_b = \{\sum_{r-1}^{R} U_{rb} Y_{rb}\} / \{\sum_{r-1}^{R} V_{rb} X_{rb}\} \qquad eq\ i$$

Subject to:

$$\frac{\sum_{r-1}^{R} U_{rb} Y_{rb}}{\sum_{i-1}^{I} V_{ib} X_{ij}} \leq 1, \forall i, j \ = \ 1,2 \ldots\ldots\ldots\ldots, m \qquad eq\ ii$$

And u_{rb},v_{ib} ≥ call r,i (where r=1,2,………,R and i=1,2……,m)

Where:

E_b is the efficiency of any unit b;
Y_{rj} is the observed quantity of output I used by unit j =1,2, ... … …, m
X_{ij} is observed quantity of input I used by unit j =1,2, ... … …, m
urb is the weight (to be determined) given to output r by base unit b
vib is the weight (to be determined) given to input r by base unit b
c is a very small positive number

u's and v's are the factors of the issue and are obliged to be more noteworthy than or equivalent to some little positive amount c to keep away from any output or inputs being completely disregarded in deciding effectiveness. Charnes Cooper Rhodes suggested that all the unit ought to be permitted to receive the best arrangement of weights. This activity will end when a portion of the efficiencies becomes 1.

RESULT

The result of the findings was presented and analyzed. Respondents for this study are the 367 terminal operators who received questionnaires. The distribution of questionnaires to respondents is shown in Table 2. Only 5% of the surveys were not returned, while 95% were correctly completed and sent back. The socio-economic distribution of Terminal Operators is shown on

Table 2.

Table 2: Questionnaire distribution

Questionnaire	Number	Percentage (%)
Responded	347	95
Non-responded	20	5
Total	367	100

Source: Researcher's Field Survey, 2022

The socio-economic characteristics of the respondents are presented in Table 3 where 37% of the respondents are female while 63% constitute the male respondents. It was generalised that male population are predominant**.** On marital status, ninety (90) respondents representing 26% of the population are single, one hundred and thirty seven (137) respondents representing 40% of the population are married, seventy (70) respondents representing 20% of the population are divorced and fifty (50) respondents representing 14% of the population are widows/widowers. It was generalised that the married occupies the larger population. On educational qualifications, forty (40) of the respondents representing 11% of the population had first school leaving certificate, forty-five (45) representing 13% of the population had SSCE, fifty-two (52) respondents representing 15% of the population had NCE, fifty-five (55) respondents representing 16% of the population had OND. Seventy (70) respondents representing 20% of the population had HND while eighty-five (85) respondents representing 25% of the population had BSc and above. It implies that majority of the respondents had first degree and above.

Concerning years of experience in the port, forty (40) respondents representing 12% of the population had at least five years' experience, sixty-five (62) respondents representing 18% of the population had between 6 to 10 years of working experience in the port. Ninety (90) respondents representing 26% of the population had between 11-15 years of working experience in the port, ninety-five (95) respondents representing 27% of the population had between 16 to 20 years of working experience while sixty (60) respondents representing 17% of the population had 21 and above working experience in the port. It was generalized that respondents with 16 to 20 years of experience form a larger part of the population and can provide valid information to questions on port infrastructure and their performance.

Table 3 Socio-economic characteristics of the respondents

Sex	**Frequency**	**Percentage**
Female	127	37
Male	220	63
Total	**347**	**100**
Marital status		
Single	90	26
Married	137	40
Divorce	70	20
Widow/widower	50	14
Total	**347**	**100**
Educational Qualification		
First School leaving Certificate	40	11
SSCE	45	13
NCE	52	15
OND	55	16
HND	70	20
B.Sc. above	85	25
Total	**347**	**100**
Years of experience		
1-5	40	12
6-10	62	18
11-15	90	26
16-20	95	27
21 above	60	17
Total	**347**	**100**

Source: Researcher's Field Survey, 2022

Factors Influencing Container Terminal Capacity and Port Performance

The finding in Table 4 presents the factors influencing container terminal capacity and port performance at the Western ports in Lagos, Nigeria. The factors assessed are port charges, stevedoring operations, the presence of unserviceable cranes, and ship calls. The data is based on a sample of 347 observations. For Port charges: the average score for port charges is 3.5706 with a standard deviation of 1.30917, indicating a high level of variability in the responses. The skewness statistic of 0.536 signifies a slight positive skew in the data, meaning more respondents gave lower scores. The positive kurtosis of 0.865 indicates a slightly leptokurtic distribution, which means the data has heavier tails or more outliers than a normal distribution.

Moreover, for stevedoring operations, the mean score for stevedoring operations is 3.5562 with a standard deviation of 1.29433, showing substantial variation in responses. The skewness is 0.515, indicating a minor positive skewness in the data, with more respondents rating this factor lower. The positive kurtosis of 0.876 shows the distribution has slightly heavier tails than a normal distribution. However, for unserviceable crane**,** the average score for unserviceable crane is 3.4207, the lowest mean among the four factors, with a high standard deviation of 1.38590, pointing to a significant spread in the data. The skewness is 0.510, suggesting a slightly positively skewed distribution, and the kurtosis of 0.996 indicates a leptokurtic distribution with heavier tails. Finally, for ship calls**, t**he mean score for ship calls is 3.3545, also on the lower end, with a standard deviation of 1.34444 indicating a substantial spread in the data. The skewness of 0.430 suggests a slight positive skewness, while the kurtosis of 0.980 suggests that the distribution has heavier tails.

Table 4: Factors Influencing Container Terminal Capacity and Port Performance

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Port charges	347	3.5706	1.30917	0.536	0.131	0.865	0.261
Stevedoring operations	347	3.5562	1.29433	0.515	0.131	0.876	0.261
Unserviceable Crane	347	3.4207	1.38590	0.510	0.131	0.996	0.261
Ship calls	347	3.3545	1.34444	0.430	0.131	0.980	0.261
Valid N (listwise)	347						

Source: Author’s field survey, (2022)

The results presented in Table 5 and 6 are Data Envelopment Analysis (DEA) of the technical efficiency of container terminals in Western ports, Lagos, Nigeria. DEA is a non-parametric method used in operational research and economics to measure the efficiency of decision-making units (DMUs) - in this case, container terminals. It uses linear programming to evaluate the efficiency based on multiple input and output measures. The analysis is input-oriented, meaning it seeks to determine how much input quantities can be proportionally reduced without changing the output quantities. It also assumes variable returns to scale (VRS), meaning that changes in output are not proportional to changes in input. This makes the analysis more realistic as it accounts for the reality of inefficiencies in operations.

Furthermore, technical efficiency was measure with CRS efficiency (crste) assumes that output changes proportionally with the level of inputs, while VRS efficiency (vrste) allows for nonproportional changes. The scale efficiency ('scale') indicates the extent to which a terminal is operating at its most productive scale size; it is calculated by dividing crste by vrste.

Table 5 presents the efficiency summary, the Terminal operators AP Moller Terminal, PCHS, and PTML have a crste, vrste, and scale efficiency of 1, indicating they are fully technically efficient under both constant and variable returns to scale. Moreover, the other terminal operators have efficiencies below 1, indicating they are not fully technically efficient. For example, Apapa Bulk Terminal Ltd has a technical efficiency score of 0.435 under CRS, suggesting it could potentially reduce input use by around 56.5% while still maintaining the same level of output. Under VRS, the technical efficiency score is 0.882, indicating better performance when variable returns to scale are considered. However, the 'irs' notation stands for increasing returns to scale, suggesting these terminals could increase their efficiency by expanding their scale of operations. Hence, the overall mean efficiency scores suggest that, on average, terminals could improve their efficiency.

Table 6 provides input slacks for the terminals, showing the excess amount of each input. A positive slack value means the input is being used inefficiently and could be reduced without affecting output. In this case, inputs 2 and 3 have positive slack for several terminals, indicating potential areas for efficiency improvements.

Results from DEAP Version 2.1
Instruction file = Eg2-ins.txt
Data file = eg2-dta.txt
Input orientated DEA
Scale assumption: VRS
Slacks calculated using multi-stage method.

Table 5: Efficiency summary

S/n	Terminal Operators	Crste	Vrste	Scale	
1	Apapa Bulk Terminal Ltd	0.435	0.882	0.493	irs
2	ENL Consortium	0.528	1.000	0.528	irs
3	AP Moller Terminal	1.000	1.000	1.000	-
4	Greenview Dev. Nig.	0.743	0.882	0.842	irs
5	TICT	0.962	0.991	0.971	irs
6	PCHS	1.000	1.000	1.000	-
7	Five Star	0.971	1.000	0.971	irs
8	PTML	1.000	1.000	1.000	-
	Mean	**0.830**	**0.969**	**0.851**	

Source: Author's field survey, (2022)

Note: crste = technical efficiency from CRS DEA
vrste = technical efficiency from VRS DEA

scale = scale efficiency = crste/vrste

Table 6: Summary of input slacks

firm input:	1	2	3	4
1	0.000	288.986	9.197	0.000
2	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000
4	0.000	345.432	24.191	0.000
5	0.000	295.334	3.149	0.000
6	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000
mean	0.000	116.219	4.567	0.000

Source: Author's field survey, (2022)

The findings show that four factors were influencing container terminal capacity and port performance. These four factors show differing levels of influence on the terminal capacity and port performance based on the mean scores. Port charges and stevedoring operations have slightly higher mean values, suggesting a greater influence on port performance and terminal capacity. Meanwhile, unserviceable cranes and ship calls have lower mean values, indicating less perceived influence. However, all four factors have significant standard deviations and slightly positively skewed distributions, indicating that perceptions varied widely among respondents. The leptokurtic nature of the data for all four factors suggests the presence of outliers that could be worth investigating further. These findings can be corroborated with previous findings, for port charges, high port charges can disincentive shippers, potentially reducing a port's competitiveness and throughput capacity Trujillo & Tovar, (2007). It's a critical factor in deciding the port of call by the shipping lines, thereby affecting the terminal's capacity utilization. For, stevedoring operations, the efficiency of stevedoring operations directly impacts the terminal's performance. Efficient operations can reduce ship turnaround time and enhance cargo handling capacity Notteboom, (2006). For, unserviceable crane, the availability and efficiency of cranes and other handling equipment are crucial to a port's operational efficiency. Unserviceable cranes could cause bottlenecks, lengthening the cargo dwell time and reducing the terminal capacity Cullinane & Wang, (2006). Lastly, for, ship calls, the frequency and volume of ship calls directly affect the throughput of a terminal. More ship calls typically suggest higher cargo volumes, potentially stretching the port's capacity Woo et al., (2011)

The DEA findings for the technical efficiency of container terminals in Western ports, Lagos, Nigeria reflect the application of Data Envelopment Analysis as a benchmarking tool in port operations, which is well-established in the literature. For, efficiency measures**:** The utilization of both CRS (Constant Returns to Scale) and VRS (Variable Returns to Scale) efficiency measures in the DEA analysis is consistent with common practice in efficiency studies. CRS measures efficiency assuming output changes proportionally with input, while VRS assumes output changes non-proportionally with input. DEA's flexibility in applying different assumptions about returns to scale makes it an advantageous tool for measuring efficiency Thanassoulis, (2001). For scale efficiency, the analysis of scale efficiency as the ratio of CRS to VRS efficiency is a recognized method to understand the relationship between size (scale) and efficiency. The 'irs' (increasing returns to scale) notation suggests that a terminal could increase its efficiency by expanding operations. This is consistent with research indicating scale economies are prevalent in container port operations Cullinane, Wang, & Song, (2005). For input slacks, the use of input slacks to identify potential reductions in input use without affecting output is a recognized DEA technique. Research suggests that identifying and reducing input slacks can significantly improve operational efficiency. Cooper, Seiford, & Zhu, (2011). Overall, these findings are consistent with other studies indicating substantial variability in the efficiency of port operations, often linked to differences in management practices, technologies, and scale of operations Wang & Cullinane, (2006). The identification of terminals operating at full efficiency provides useful benchmarks for other terminals.

CONCLUSION AND RECOMMENDATIONS

It was concluded that port charges and stevedoring operations have slightly higher mean values, suggesting a greater influence on port performance and terminal capacity. Meanwhile, unserviceable cranes and ship calls have lower mean values, indicating less perceived influence. It was concluded that AP Moller Terminal, PCHS and PTML are the most efficient terminal in South-Western Ports in Nigeria. The following recommendations were made

i. Periodic training and retraining of staff handling modern equipment should be priortized.
ii. Improvement of railroad connecting the hinterland should be considered in-order to reduce gridlock on the port access road.
iii. Increased port charges by the terminal operators should be addressed to encourage freight forwarders to clear their cargo on time at the port.

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