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ANALYSIS OF THE PERFORMANCE OF CONTAINER TERMINAL OPERATIONS IN TINCAN ISLAND PORT, LAGOS, NIGERIA

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Abstract

Maritime transport plays a crucial role in being many nations' major gateway for international trade and is an important tool for evaluating the economic wealth of any nation. This paper examined the annual growth rate, turnaround time, berth occupancy rate and container throughput, Tincan Island Port. Secondary data was used to analyse the collected data. Ordinary Least Square regression was used to analyse the secondary data, which are the annual growth rate of container throughput, turnaround time and berth occupancy rate. The result showed an R2 value of 92.3% (R2 = 0.923) in the annual growth rate of container throughput. However, a unit increase in the turnaround time at the terminal has a negative effect of about 8.3% on the annual growth rate. All the other variables (number of vessels, container throughput and berth rate were significant at p < 0.05 with R2 = 0.748, 0.603 and 0.031, respectively. Based on the findings of the study, it was concluded that there was an annual growth rate of container throughput and gross registered tonnage of the vessel from 2005 to 2015. It was recommended that terminal operators should invest more in modern handling equipment to ease the movement of containers at the terminal. Training and retraining of indigenous personnel by terminal operators that will handle fast and modern equipment.

Keyword: Container terminal, turnaround time, berth occupancy rate, container throughput

INTRODUCTION

Maritime transport plays a vital role in being many nations' major gateway for international trade and is a veritable tool for evaluating the economic wellbeing of any nation (Ogunsiji 2010, UNCTAD, 2007). Notably, the seaborne trade accounts for about 90 per cent of the world international trade (Gabriel, 2019). Seaport is, therefore, regarded as the strategic driver for national economic development. It comprises all enterprises involved in constructing, manufacturing, the business of designing, supplying, operating, repairing and/or maintaining vessels, or component parts: managing and/or operating shipping lines, freight forwarding, custom brokerage services, marine docks, shipyards, dry docks, marine railways, stevedoring services and similar enterprises. These enterprises can be linked with the various parastatals and agencies, and other players in the private sector (Branch, 1986).

Maritime transportation has the largest share among all other transportation modes with its cost-effectiveness. Regarding growth in container traffic, ports business grown into a much more challenging environment. It is, therefore, crucial to the proper operation of any country's economy and an essential component of a nation's transport infrastructure. Igbokwe (2001), asserted the statement that transport is to the Nigerian economy what the artery is to the blood circulation. Therefore, ports are highly significant in facilitating international trade. They are component of the international supply chain network (Pomeroy, 1994). The ultimate purpose of a container terminal is to manage vessels at the place of the berth, inbound container unloading, outbound container loading and storage yards as aptly as possible. Such an objective can be achieved by coordinating the berthing time of vessels, the resources needed for handling the workload, the waiting time of customer trucks and, at the same time, ensuring that congestion is reduced on the roads, at the storage blocks and docks. Each of these activities cogently influences port efficiency with consequences on the local and global economy of the freight transport system. (Armando and Francesco, 2010) However, in Nigeria, Nigerian Ports Authority regulates the activities of the ports, ensuring that all activities are in the interest of the port, administers land and ensures the maintenance of the infrastructure including the depth of the berths (Pinwa, 1999). Nigerian Ports Authority (NPA) constructs specialised ports such as the container Terminal and RORO ports all in Lagos. This Authority enjoys operational benefits of terminal ownership: it ensures, by priority use of the facility, a level of service tailored to the line and it allows exercising a greater dominance over costs. Sadly, the situation in Nigerian ports is intolerable due to some factors influencing the operational performance of container terminals. These constraints are constraints of berth allocation and scheduling, handling equipment, storage yard capacity and the delivery system (Somuyiwa and Ogundele, 2015).

Onwumere (2008) asserted that vessels on arrival consume more time waiting to berth and consequently, more ships tend to queue at the channels and outside the bar waiting for berthage. This often results to delay and congestion in the terminal. His view was that congestion arises when cargoes coming into the port are more than what the storage facilities can handle. Similarly, Emeghara (1992) asserted that from 1975-76, ship congestions at the Nigerian seaports were not due to lack of berthing facilities, but due to the fact that the cargoes stacking areas were not relieved of traffic as early as they should be. He further explained that inefficient, inadequate and cost-effective transport linkages with the hinterlands of the ports pose operational problems which mitigate against capacity utilisation. This paper was set out to analyse the performance of container terminal operations in Tincan Island Port and to suggest possible solutions so as to ensure a sustainable system.

LITERATURE REVIEW

Transport researchers have simply described a seaport as a geographic nodal point along a given shoreline where the mode of transportation changes from land to sea or water, or vice versa and involves the provision and presence of geographical opportunities and merits, socio-economic potentialities and endowments, state of technological advancement and political considerations (Patrick, 1999). Studies have shown that a port provides for the transfer of cargo from one mode of transportation to another. Olaogbebikan *et al*, (2014) defined port as a location on a coast or shore constituting one or more harbours where ships are docked and transfer people or cargo to or from the land. Port locations are selected to optimise access to land and navigable water, for commercial demand, and for shelter from wind and waves. A port comprises of three elements, and they are:

Physical structure: This includes wharves, dock, storage, space and cranes

Port Authority: The management of the business entity

Service providers: Such as longshoreman and terminal operators.

However, the Nigerian Ports Authority owns the land and infrastructure and the infrastructure is leased to private operating companies. The private operating company provides and maintains the equipment and employs labour to handle cargo. For this kind of port, only the cost of infrastructure falls under the account of the Port Authority; the stevedore covers all other costs. Tincan Island port which serves as the scope of this study consists of one or more container terminals.

Productivity Concept

The concept of productivity is defined as a ratio of the volume measure of output to the volume measure of input used, whereas efficiency is a relative concept, i.e. the performance of a firm is compared to a benchmark (OECD, 2001). Karen (2001) traditionally defined productivity by the production function, which correlates quantities of input with quantities of output. However, there is a difference between productivity and output. A port, for example, could handle more cargo at a berth by employing more men per gang, more gangs, more equipment and building more storage space. You will certainly be increasing berth output but not necessarily improving productivity. Marlow and Paixo (2003) argued that most researches conducted on port productivity are based on quantitative measures, as it is easier in assessing port performance. Ports are regarded as service-oriented; therefore, efficiency is of great However, Meyrick and Tasman Asia Pacific (1998) asserted that there are two categories of partial productivity measures which have been used in port productivity studies. Firstly, labour productivity which is the annually lifts per employee and is defined as the number of container movements (container lifts) per terminal employee. Secondly, net crane rate (capital productivity), and is defined as the number of container movements (container lifts) per net crane hour. This is the keyword of an efficient container terminal to show to the stakeholders for high productivity.

JOC (2013) was of the opinion that Marine terminal productivity in individual scenarios isn't an unalterable reality based on local circumstances of labour, capital, management, infrastructure and politics. Rather, productivity is of great importance, as ports themselves factor into trade facilitation - where effectiveness in productivity translates into spinoff benefits or bottlenecks in supply chains, availability of goods on store shelves, employment. However, some literature in port productivity has their major focus on terminal equipment such as yard crane and truck (Ng, 2003) quay crane (kim et al, 2004: Kozan, 2001) and rubber-tyred gantry crane (zhang et al., 2002). Their focus is to ensure that terminal operators are able to maximise these kinds of equipment. In maritime subsector, Tongzon, (2005) revealed that port productivity and performance are measured in terms of a number of containers moved through a port, known as cargo throughput, on the presumption that ports are throughput maximisers. He also suggested an alternative port performance indicator easier than UNCTAD, (1976) postulated, when he focused on location, frequency of vessel calls, port charges, economic and terminal efficiency, which Tongzon (1994) harmonised into three: economic, location and operational. However, JOC, (2013), argued that improving terminal productivity is becoming more urgent, in large part because vessels are getting ever larger. Importance in determining moves per hour for loading and discharging container from and onto the vessel.

The largest ship afloat in 1990 could uphold 4,800 20-foot-equivalent container units. Today, vessels in the major trade lanes typically carry 8,000 to 13,000 TEUs. Hence port productivity concept is a viable concept used in measuring port performance.

Functions and configuration of the container port/terminal

The container was designed to improve handling efficiency, primarily port handling efficiency, but also for all the handling between different transport modes. Standardisation of cargo handling, therefore requires highly specialised facilities (Qianwen, 2010). The facilities of a container port are the same, regardless of their size and regulatory policy. The basic function of a seaport is to transfer goods and passengers between ships and shore and/or between ships (Goss, 1990).

The basic function of a port is to provides different kinds of facilities and services. The World Bank classifies port assets into four different categories: basic port infrastructure, operational infrastructure, superstructure, and equipment. Table 1 explained the categories of port assets.

Table 1: categories of port assets

Basic infrastructure	Access channel, breakwater, locks, berths, rail and road connection
Operational infrastructure	Inner channels and turning, revetments, quay walls, jetties, navigation aids, buoys, beacons, mooring docks
Superstructure	Paving, surfacing, lighting offices, repair shops
Equipment	Tugs, line handling vessels, dredging equipment, ship and shore handling equipment and cargo handling equipment

Source: World Bank (2007, p. 95)

Container ports are multifaceted organisations accommodating multiple simultaneous activities, e.g. tugging, pilotage, mending, etc., but container handling is the principal function of a container port, with handling constituting over 80% of the charges faced by a carrier bringing a container vessel to a port for loading and unloading (Tovar, Trujillo and Jara-Diaz, 2004). According to Qianwen (2010), a container port consists of one or more container terminals. In order to convey containers from ship to shore and within the port, the prerequisite facilities include berths for ships to park, area for container stacking and storage, and handling equipment to load and offload containers. Among those facilities, the container handling equipment differentiates container ports from other ports.

There is a huge diversity of container handling equipment, but they can be classified into two main groups: quay crane and yard handling system. On the quayside, containers are transported between ship and shore and container quay cranes are the main equipment used for ship loading and unloading. It can be either mounted on the ship (ship-mounted cranes), or located on the quay, ship-to-shore (STS) cranes; the latter is widely used in container ports and terminals. On the yard side, containers are transferred to land transport modes or are arranged to be loaded on to other ships. Two types of activities occur in the yard area: stacking of container and horizontal transport. Before containers are moved away they are stacked in the yard area. Stacking equipment for containers includes Straddle Carriers, Rubber Tired Gantry Cranes (RTGs), Rail Mounted Gantry Cranes (RMGs), Reach stackers, and Stackers for Empty Containers. Horizontal terminal transport is the movement of containers between the STS, the stacking area, and the landside operation. Equipment for horizontal transport includes trucks, trailers, straddle carriers, Automated Guided Vehicles (AGV), and reach stackers.

In addition to the handling facility, terminal size, berth length, storage and trained labour are all important to the operation of container handling. A container port can be seen as the collection of its terminals in terms of physical structure. However, the operation objectives of ports and terminals cannot be compared because the operating agents are different (Liu,2010).

METHODOLOGY

Tincan Island Port Complex was used as the study area. It is situated in Apapa, Lagos, Nigeria. It is about seven kilometers due west of the city center of Lagos across Lagos Harbor Wikipedia, (2016). It is termed as the second busiest Port in Nigeria after Apapa Port with her coordinates 6.4328° N, 3.3452° E and has bearing of Latitude 62^0N Longitude $30^0$23E.

Secondary data were used for the purpose of this study. The secondary data was obtained from Nigerian Ports Authority. Both descriptive and inferential statistics were used to analyse the data. Ordinary Least Square Regression was used to analyse the data. Figure 1 show the digital map of the study area.

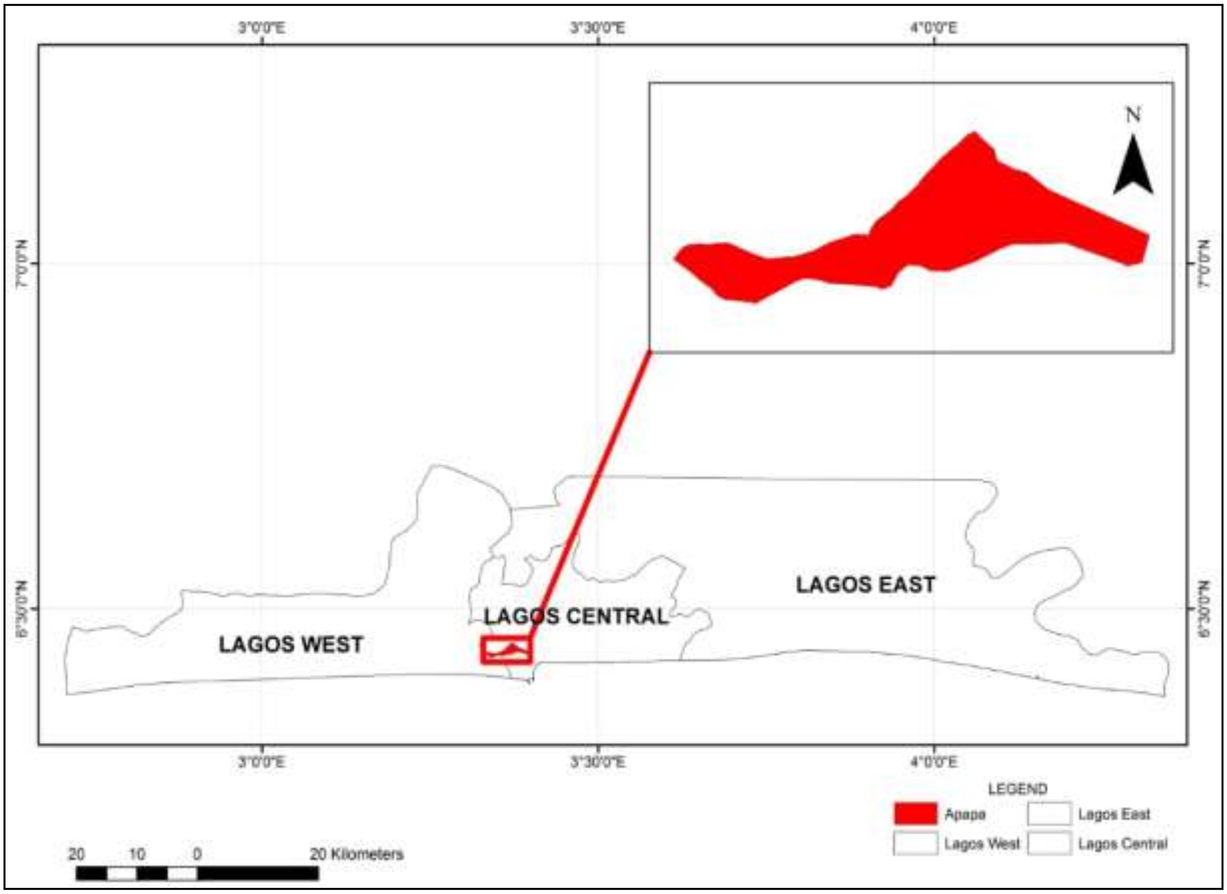

Figure 1: Digital map of Tincan Island Port, Lagos

Source: Department of Survey and Geoinformatics, University of Lagos, Nigeria (2016)

RESULTS AND DISCUSSION

Table 2 shows the annual Growth Rate of container throughput turnaround time and berth occupancy rate from 2005 to 2015. Figure 2 shows the trend of container throughput from 2005 to 2015. There is an increase in term of container throughput from 2005 to 2013. This is an upward trend. However, there is a downward trend from 2013 to 2015. The economic recession was the factor that causes a decrease in the trend of container throughput from 2013 to 2015.

However, Okedu (2013) asserted that there was an annual growth rate of cargo throughput in the year 2013. This due to port reforms in the Nigeria maritime industry. Olaogbebikan *et al*, (2014) opined that the concession of the port is responsible for this upward movement in cargo trend.

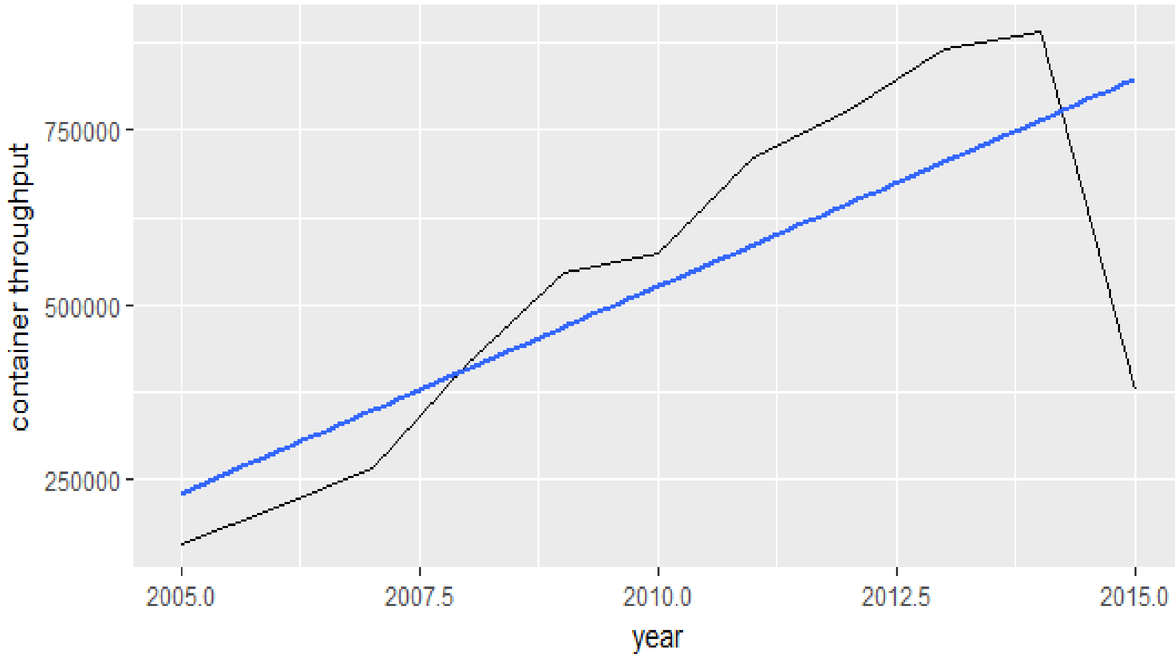

Figure 2: Graph of container throughput

Figure 3 shows the downward trend of turnaround time from 2005 to 2015. It decrease drastically from an average of 9.00 days to 4.27 in 2011 and increase to 5.25 days in 2012 and later drop to 4.13 days in 2015.

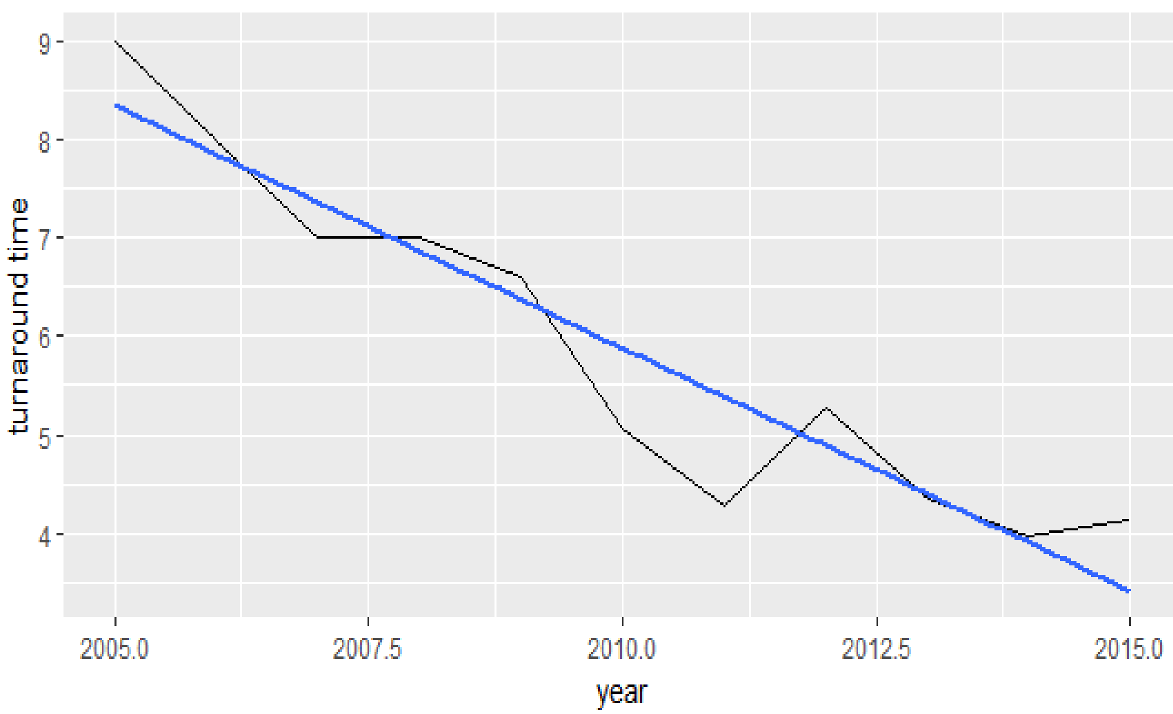

Figure 3: Graph of turnaround time

However, Olaogbebikan *et al*, (2014) stated that turnaround time of vessel is high at the average rate of 5.25 days in 2012 as against the International Maritime Organization 48hrs stipulations. Moreover, the drop in the turnaround time in the year 2015 is due to modern cargo handling equipment.

Furthermore, figure 4 shows the trend of berth occupancy rate from 2005 to 2015. The berth occupancy rate increases immediately after concession era from 2005 to 2007 and drop 2008 then later increase from 2009 to 2010 and decline in the year 2015. Similarly, Omoke *et al* (2015) asserted that the substantial decline in 2008 could be seen as a natural trend or pattern observable in relationships portraying changes in demand and supply capacities of goods and services.

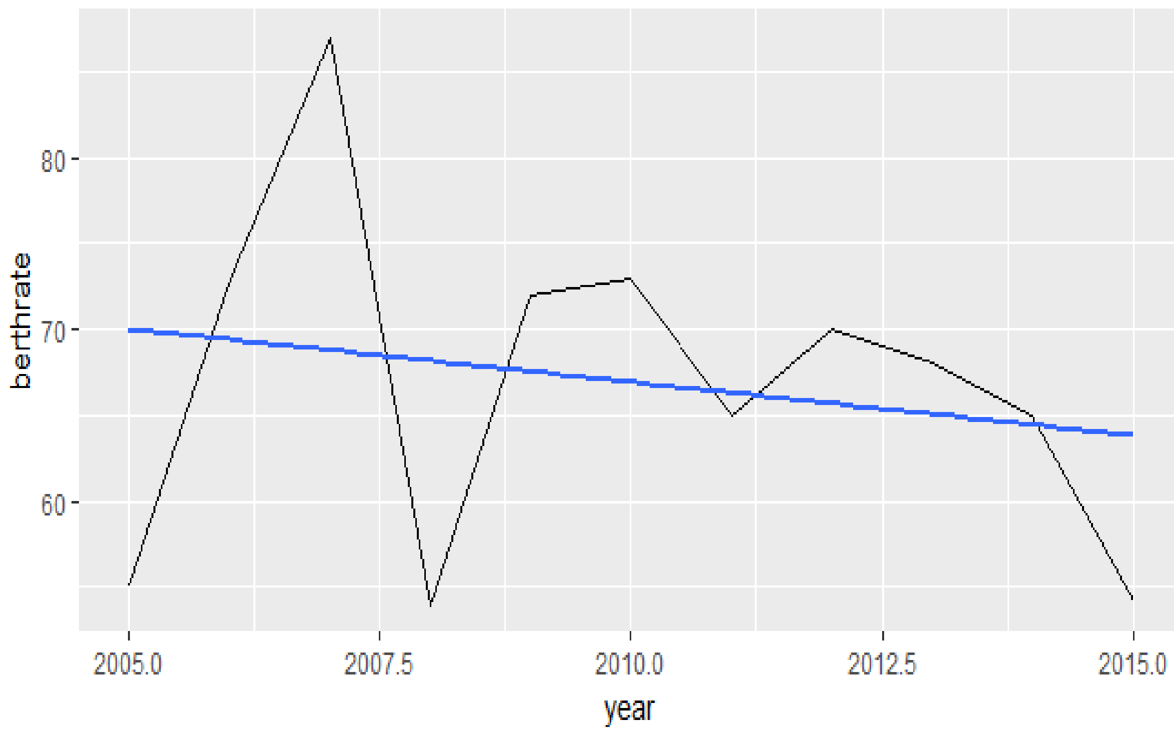

Figure 4: Graph of berth occupancy rate.

Table 2 analysed the annual growth rate of container throughput turnaround time and berth occupancy rate from 2005 to 2015. Average annual growth rates were calculated for each period by the least-squares regression method. The least-squares growth rate, *r*, is estimated by fitting a least-squares trend regression line to the logarithmic annual value of the variable in the relevant period.

Vc = vessel no,

vcgrt = vessel gross registered tonnage,

ctnerthr = container throughput,

Turntime = turnaround time,

berthrate = berth occupancy rate.

T = is the time (year), and

a and b are the parameters to be estimated;

a = constant

b = slope

e = the error term.

If *b** is the least-squares estimate of b, then the average annual percentage growth rate, *r*, is obtained as [antilog (*b**)] – 1 and is multiplied by 100 to express it as a percentage.

Table 2: OLS of annual growth rate

	Dependent variable:				
	log(vcno)	log(vcgrt)	log(ctnerthr)	log(turntime)	log(berthrate)
	(1)	(2)	(3)	(4)	(5)
Trend	0.082***	0.165***	0.138***	-0.083***	-0.008
	(0.016)	(0.016)	(0.037)	(0.009)	(0.015)
Constant	6.846***	16.266***	12.348***	2.147***	4.233***
.	(0.094)	(0.094)	(0.220)	(0.054)	(0.087)
Observations	11	11	11	11	11
R^2	0.748	0.923	0.603	0.902	0.031
Adjusted R^2	0.720	0.914	0.559	0.891	-0.077
Residual Std. Error (df = 9)	0.167	0.167	0.390	0.096	0.154
F Statistic (df = 1; 9)	26.675***	107.871***	13.670***	82.715***	0.285

Note: *p**p***p<0.05

Across the years under observation, (i.e. 2005 to 2015) gross registered tonnage shows the highest R^2 value of 0.923 i.e. 92.3% in annual growth rate of container throughput. However, a unit increase in the turnaround time at the terminal has a negative effect of about 0.083 on annual growth rate. All the other variables (number of vessels, container throughput and berth rate are all significant at $p < 0.05$ with $R^2 = 0.748$, 0.603 and 0.031 respectively. Among all these identified variables, berth occupancy rate is at the lowest ebb based on these findings with reference to years under observation.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, it was concluded that there was an annual growth rate of container throughput and gross registered tonnage of vessel from 2005 to 2015. It was also revealed that there is a downward trend of turnaround time from 2005 to 2015. Similarly, there was an increase in the annual growth of berth occupancy rate which later decline in 2008 due to unknown variables. Omoke *et al* (2015) asserted that the substantial decline in 2008 could be seen as a natural trend or pattern observable in relationships portraying changes in demand and supply capacities of goods and services. The following recommendations are put forward based on the findings of the study:

i. Sophisticated equipment that will ensure the optimisation and utilisation of vessel traffic should be provided.
ii. Terminal operators should invest more on modern handling equipment to ease the movement of containers at the terminal
iii. Training and retraining of indigenous personnel by terminal operators that will handle fast and modern equipment.
iv. Policy that will enhance the productivity of container terminal operations should be enacted

SCOPE FOR FURTHER STUDIES

Southwestern ports can be adopted for further studies which comprise of Tincan Island port and Lagos port complex in Nigeria. Other reviews can also examine the idle time of vessels at berth and the dwell time of cargo at the terminal.

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