AN EVALUATION OF PORT OPERATIONS PERFORMANCE IN NIGERIA: CASE OF CALABAR FREE PORT

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Abstract: The study evaluates port operational perfomance and factors afecting the ports in Nigeria focussing on Calabar port. Data was sourced from Nigeria Ports Authority Annual report of Calabar port from 2007-2013. The research used multiple regression model to analyze the data using SPSS software package version 23.0. The regression model variables used were Y(cargo throughput) as dependent variable on X_1, X_2, and X_3 as (number of vessels, turnaround time, number of employees); all explanatory variables were explained for a period of seven years. The result shows the output summary of Calabar port R square as 99%, which is very good. It means that the port's operational performance is at the high level. From the test of hypothesis, the overall result shows that P-value calculated is equal to 0.003 which is less than the tabulated alpha value of 0.05, therefore alternative hypothesis is accepted, which means that there is a statistical significant relationship between cargo throughput and number of vessel traffic, turnaround time and number of employees of the Calabar port. Policy implications were made on how those factors can be improved.

Keyword: Ports Performance, Turnaround, Shippers, and Cargo throughput

INTRODUCTION

Maritime transport is one of the oldest forms of transport system in Nigeria. It is the main form of international transport system that has significant economic impact in the history of Nigeria. This is because Nigeria is blessed with various water bodies such as the Atlantic Ocean, lagoons and other rivers. The water transport system has faced a lot of constraints which makes it difficult to use as a reliable means of transport because most of the cataracts and creeks are seasonal waterways that can only be navigated during the raining seasons while the inland waterways dry up in the dry season. Also, most of these waterways possess rocks, lowlands, hills, and rapid waterfalls making it difficult for navigation [1].

In international and domestic trade, sea transportation plays a vital part in economic growth as the movement of bulk cargo over very long distance is most economically done by sea. Maritime transportation is the gateway of any developing economy. Alfred is of the opinion that seaborne trade accounts for over 90 % of global trade, thus showing the level of credence in sea transportation for the movement of cargo generated for global trade [2]. Ports are also points of convergence between two geographical domains of freight circulation. The port is a major maritime gateway for global trade and a good tool for ascertaining the economic development and health of a nation [3]. This aims at serving the prosperity and welfare of our regional or national community that goes beyond our borders to making positive contributions in improving the quality of lives.

A consideration of Nigeria's large coastal water and seaports (predominantly in the Southern region of the country) reveals that the maritime sector has contributed substantially to the economic development of the country. It is not surprising that a large volume of the country's international trade is in one way or the other connected to the maritime sector; for instance, the distribution of the crude oil and related products from the various oil wells in the country is distributed to the international buyers through the various seaports and maritime routes of the country. This perhaps explains why Ndikom views a port as a gateway to the nation's economy, with shipping services being a primary logistic service of critical importance. This impact is not peculiar to Nigeria as there are suggestions of similar impacts in other countries [4]. For instance, the observation by Trujillo that there are 2,814 international ports catering for freight traffic in the world is an indication of the level of business activities associated with the maritime sector across the world [5]. It is estimated that port traffic increases at an average rate of 3% per year, with nearly 90% of goods exchanged through international trade facilitated through the maritime transportation network. The United Nations Conference on Trade and Development believes that a large share of international trade would not have been possible without the infrastructures provided by seaports, regarded generally as the interface between maritime transport and land transport or inland navigation [6].

Operational efficiency is associated with port performance. Physical qualities of items used, scale or scope of activities, levels of efforts expanded, and the efficiency to convert resources into port services captures the centre stage. Indicators like capital facilities expenditure per ton of cargo, revenue per ton of cargo, berth occupancy, number of gang employed, and vessel turn-around time are used as avenues to measure recent operational performance against previous year performance and against competitor performance, so as to produce efficiency goals.

Maritime industry is global in nature and very dynamic component in the socio-economic configuration of any maritime business in Nigeria. Countries such as Niger, Burkina-Faso and Mali in West Africa are landlocked. This hinges on their economic fortunes in the maritime sector, as they rely on the ports of Apapa, Cotonue, and Abidjan for import and export activities. The Nigerian shipping industry confronts a danger of steady eradication as a result of poor operational performance in the seaports [3]. Maritime transport investment is one of the major transport sector that requires various infrastructural investment and as well large equipment facilities which enhances its maritime operation. This is because maritime transport (sea port) accommodate large vessels and other maritime and international shipping which helps in the economic development of the nation [7].

The condition of Nigeria maritime industry calls for serious attention on the area of infrastructure and high tariff at the seaports. The Maritime community has been drowning in high level of inadequacies that have crippled shipping activities in the Nigerian ports. This occurs severally as a result of the gross mismanagement and incompetence of port activities and operations, and lack of adequate infrastructure for proper cargo handling and shipping operations. Poor government policies are also another major challenge facing the Nigerian port operation, which has caused the port much loss in the area of ship calls and maritime activities at the port. As a result of this, most port users (shippers and shipping companies) are diverting their cargo to the neighbouring ports. With such policies, the ports will be losing a lot of revenue due to the diversion of the ships to the neighbouring countries.

Congestion within the port environment of Tin can and Apapa and shallow entrances of the major routes leading to the Eastern ports, are other problems facing the ports in Nigeria. Congestion at the port affect shipping activities that result to poor performance and inefficient shipping activities, decrease in turnaround time for vessels and high container dwell-time. The average waiting time of ships in the Eastern seaports of Nigeria seaports is at its barest minimum since most berths seem to remain empty. Though the average turnaround time of vessels remains low when compared to the turnaround time of ships in developed countries. The berths are more in number when related to the volume of calling ships [8]. Due to the competition between the major seaports in the Niger Delta region namely Onne port complex, Rivers port complex, Delta port complex and Calabar port, the notable problem in this study is the act of not performing up to expectation when it comes to cargo trafficking and port operation as a whole, there by resulting to a situation where the ports employ different strategies to compete for more cargo traffic and dominate over the other ports in terms of efficiency.

The privatization of terminal operations is expected not only to increase technical expertise and the degree of involvement of expatriates in management, increase the potential for diversification [9], but also lower the costs associated with running the ports [10]. Furthermore, according to [11], port privatization leads to a quicker response to changes in the market, and faster adaptation to changes in both maritime transport technology and intermodal transport. It could therefore, be argued that port privatization increases efficiency, productivity and competitiveness. This is, however, contingent upon the preparedness to adapt new innovations and roles in the management of the changing market environment [11]. Earlier studies that tried to identify factors that influence the choice of ports suggest that port efficiency is a decisive factor. Thus, port efficiency leads to a high level of port throughput if effectively managed.

African ports more especially Nigeria ports are still an understudied field, while diverse ports from other parts or regions around the world have been analysed by the three most common approaches in efficiency management: ratio analysis [12], the econometric frontier [13-21], and DEA, which may vary in terms of popularity among researchers [22].

Besides, there are scarce studies that discuss the quality of data on remote corners of the globe such as Africa. These scarce studies on African ports include [23] who measured the efficiency level of Nigerian ports after the implementation of policy reforms with a focus on the Onne and Rivers ports. Omoke, Diugwu, Nwaogbe, Ibe, and Ekpe conducted a study on infrastructure* financing measuring the results of terminal privatization in Nigeria [24]. Additionally, [25] assessed port efficiency in West African countries using DEA. Nwanosike, Tipi, and Warnock-Smith employed Malmquist indexes to benchmark pre-and post-reform total factor productivity growth in Nigerian ports [26]. The results indicate that the source of pre-concession period productivity growth was technological progress while the change in productivity of the post-concession period is geared towards increases in scale efficiency (SE).

Moreso, [27] studied on Efficiency in Nigerian ports, handling imprecise data with a two-stage fuzzy approach. The study focused on assessing the efficiency of six major Nigerian ports from 2007 to 2013 by applying a two-stage fuzzy-based methodology adequate to handle imprecise data. Fuzzy data envelopment analysis models for traditional assumptions with respect to scale returns are employed to assess the productivity of Nigerian ports over the course of time. In the second stage, fuzzy regressions based on different rule-based systems are used to predict the relationship of a set of contextual variables on port efficiency. These contextual variables are related to different aspects of port service level, berth utilization, accessibility, cargo type and operator type. The results reveal the impact of operator and cargo type on efficiency levels. Policy implications for Nigerian ports are derived.

Infrastructure financing and Management, impact of concession on the operations and performance of Nigerian seaports, was studied by Omoke, Diugwu, Nwaogbe, Ibe, and Ekpe. The study examined the effect of privatization on the performance of Nigerian seaports, using pre- and post-privatization data. A Mann-Whitney Wilcoxon (MWW) test was applied to data (secondary) on two major indices of port operation (average berth occupancy and average turn-around time). The result of the analysis showed that on average, the berth occupancy and turn-around time improved from 51.35% to 72.47% and 8.18 days to 4.83 days respectively. It was also found that at a 0.05 level of significance, the concession of Nigerian ports has significantly improved average berth occupancy and average turnaround time of the vessels calling at Nigerian ports. The study emphasises the need to provide enabling environment through the formulation and implementation of effective policies as a way of ensuring optimal performance of the concession model [24].

Omoke, Aturu, Nwaogbe, Ajiboye, and Diugwu studied on competitiveness analysis of selected seaports in West African coast region using Analytical Hierarchical Process (AHP). The study analysed the competitiveness of selected ports in West Africa Coast region with respect to vessel traffic, cargo throughput, and container traffic. The result reveals the percentage competition of each port during the study, it shows that Apapa port with (26.36%), is the most competitive port among the selected ports. It is 1.21 times more competitive than Tema port (21.41%), 1.48 times more competitive than the Tin-Can Island port (17.85%), 2.05 times better more competitive than Cotonou port (12.86%), 2.10 times better than Lome port (12.56%) and 2.94 times more competitive than Takoradi port (8.96%). The order of overall port competitiveness is Takoradi < Lome < Cotonou < Tin-Can < Tema < Apapa [28].

Nwaogbe, Pius, Balogun, Ikeogu, and Omoke studied on analysis of impact of port operations on Nigerian economy, with a focus on Apapa port. The specific objectives were to

determine the impact of gross registered tonnage of vessels on Nigerian gross domestic product, ascertain the influence of cargo throughput on Nigerian gross domestic product, as well as determine whether ship traffic significantly influences Nigerian gross domestic product. Data sourced from Nigeria Ports Authority's operational bulletin were analysed using the multiple regression model. It was found that gross registered tonnage of the vessel is significantly contributing to the Nigerian gross domestic product (GDP) at 0.05 significant level, and that cargo throughput and vessel traffic have positive impact on the economy but are not significantly influencing the Nigerian gross domestic product at 0.05 significant level. The paper recommends that vessel gross registered tonnage should be used as the basis for assessing port dues since it bears positive significance on Nigerian economy [29].

Aim and Objectives of the Study

The aim of this study was to assess performance of seaports in the study area. The aim was achieved by the following objectives:
1. To assess the number of vessels called at the seaports in the study area.
2. To analyse the cargo throughput of the seaports in the study area.
3. To assess the turnaround time of vessels at the port of call in the study area.

Research Hypothesis

In order to carry out an adequate research work and to analyse the relationship of the needed variables, the following hypotheses were raised.

H_0: There is no significant statistical relationship between cargo throughput and turnaround time.

H_0: There is no significant statistical relationship between cargo throughput and number of employees.

H_0: There is no significant statistical relationship between cargo throughput and number of vessels.

Study Area

Calabar port is seated along latitude $4^0$55'N and Long $8^0$15'. 3. E. The Port is at about 55 nautical miles from the fairway buoy up to Calabar River. It sits on an area of about 38 hectares of land-buoyed channel 150 meters wide and a navigable channel 85km ($45m^2$). There are four Quays at the port, each measuring about 215m long and 40m wide. These Four Quays are divided into six functional berths. The Port also has two warehouses measuring 175m X 40m and 150m X 40m. The Port operational Area has been divided into two concessioned terminals. Terminal A which is made up of two berths was concessioned to Intels Nigeria Ltd. And Terminal B which is also made up of four berths was concessioned to ECM Terminal Nigeria Ltd. The operation of the Calabar port had been ceded by the Ports Authority to reputable private terminal operators. However, the ports Authority still plays its role as a regulator and provides harbour and ancillary services like towage, pilotage, provision of navigational aids, repair and maintenance of common user area, and maintenance dredging of the port channel.

Fig. 1 *Map of Nigeria indicating the study area*

1 METHOD AND MATERIALS

1.1 Design of Study

Historical research design is used. The research systematically studied the port of Calabar in the Niger Delta region in order to generalize the findings for the whole population of the ports. It is historical because it involves the record of the past records of cargo throughput, numbers of vessels that calls at various ports, turnaround time of vessels, types and capacities of handling equipment at the port, which are sources from annual publications, official records, ships records, cargo throughput results from port records.

1.2 Method of Data Collection

Secondary data were collected from Nigeria Ports Authority book of abstract and Calabar Port annual reports. Interviews were also conducted with some of the staff of the Calabar Port.

1.3 Method of Data Analysis

To achieve the objectives and to test the hypothesis of the study, descriptive, multiple regression's analysis, and one-way analysis of variance (ANOVA) was used for the data analysis. Statistical Package for Social Science window version 23.0 (SPSS) program was used to analyse the data. Multiple regression model is stated as:

$$\hat{Y} = \alpha + \beta_1(x_1) + \beta_2(x_2) + \beta_3(x_3) + \cdots\ldots + \beta_n(x_n) + e_n$$

Where, Y = dependent variable, x_n = independent variable, α = constant, and $β_n$ = coefficient of x, e_n = error term.

Where the dependent variables are: Y_1 = Cargo throughput (CARGO TP), While the independent variable x_1, x_2, … , x_n are given as follows: Number of employees (NO. EMP), number of vessels (SHIP T) and Turn-around time of the ship (TAT).

1.4 Data

Data used for the analysis are presented in the table 1 below. The variables were used in analysing the raw data. They are; Dependent variables are Cargo throughput, while the Independent variables are turnaround time, number of vessels, number of employees.

Tab. 1 *Output and Input Data Characteristics*

CALABAR				
YEAR	CARGO TP	SHIP T	TAT	NO.EMP
2007	949523	897	2.23	459
2008	1153117	351	3.48	254
2009	1721249	321	3.78	424
2010	1594277	197	3.37	422
2011	1878753	179	4.05	411
2012	1723195	159	3.43	402
2013	1732286	373	4.12	395

Source: NPA .Website

2 DISCUSSION OF RESULTS

2.1 Analysis for Calabar port

This section shows the data analysis; data analysed and the results of findings for Calabar port. The data gathered are examined for a more appropriate knowledge of the data. It statistically presents the data/information gathered from secondary sources. Each of the analysis is done with two set of variables, where one is the dependent variable (Y) and the other is the independent variable/predictor (X).They are; Dependent variables: Cargo throughput and Independent variables are: turnaround time, number of vessels, and number of employees.

Tab. 2 *Descriptive Statistics*

	Mean	Std. Deviation	N
Cargo_T	1536057.14	346246.016	7
Ship_T	353.86	254.822	7
Turn_AT	3.49	0.632	7
No_Emp	395.29	65.640	7

The descriptive statistics as shown in table 2 above, are large and the implication is that the original data is sourced from the Nigeria Port Authority (NPA) direct and it shows that the data is real, not estimated data. The original data used to compute the standard deviation is shown in table 2 above. The result shows the mean of the variables used for the analysis.

Tab. 3 *Correlations*

		Cargo_T	Ship_T	Turn_AT	No_Emp
Pearson Correlation	Cargo_T	1.000	-0.803	0.833	0.221
	Ship_T	-0.803	1.000	-0.775	0.257
	Turn_AT	0.833	-0.775	1.000	-0.263
	No_Emp	0.221	0.257	-0.263	1.000
Sig. (1-tailed)	Cargo_T	.	0.015	0.010	0.317
	Ship_T	.015	0.0	0.020	0.289
	Turn_AT	.010	0.020	0.0	0.284
	No_Emp	.317	0.289	0.284	0.0
N	Cargo_T	7	7	7	7
	Ship_T	7	7	7	7
	Turn_AT	7	7	7	7
	No_Emp	7	7	7	7

The table 3 above shows the Pearson correlation and 1-tailed test result. The correlation analyses show notable positive relationships between the dependent and independent variables, which are, therefore, isotonic and justified to be included in the model [25]. The correlation analysis for the Nigerian seaport variables shows various significant relationship between the dependent and independent variables of the regression model for the Pearson correlation model analysis. From table 3 above, it shows the correlation between cargo throughput and ship traffic as -0.803 (-80%), meaning that there is no relationship between the dependent variable and the independent variable. This means that the number of ship traffic that brought the cargo to Calabar port is far less than average. For cargo throughput and turnaround time, result, shows 0.833 (83%), which means that there is notable relationship between the dependent and the independent variable. Between the cargo throughput and number of employee, the analysis shows 0.257 (26%) in the table, meaning that there is a very weak significant relationship between the dependent and independent variable; while on the turnaround time and number of vessel, the result shows 0.775 (76%). This means that there is a notable relationship between the turnaround time and number of vessel traffic, which means that turnaround time of the vessels in Calabar seaport is on the averagely lower side, the relationship show that there are much vessel delays in the Calabar.

Moreso, the correlation of number of employees and number of vessel traffic shows a result 0.257 (26%), meaning that there is a weak relationship between the number of employee and number of vessel, this means that the number of employee that work at Calabar port does not have enough capacity to handle the number of vessels calling at the port. Which means that it will result to delay of vessels at the port thereby causing much delay in cargo clearance and documentation by the shippers and the clearing and forwarding agents together with the shipping companies; while the number of employees and turnaround time shows a result of -0.363(-36%), meaning that there is a very weak relationship between the number of

employee and turnaround time~;~; this result shows that due to low number of employee, there will be a very low turnaround time of the vessels at the port and this is the major factor facing Calabar ports which make it to be unattractive.

Tab. 4 *Model Summary* [b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.993[a]	0.987	0.973	56819.797	0.987	73.268	3	3	0.003	1.890

[a] *Predictors: (Constant), No. Employee, Ship Traffic, Turnaround Time*
[b] *Dependent Variable: Cargo Throughput*

The above table 4 revealed the cumulative estimated regression model result of Nigerian seaport given the levels of both the dependent and independent variables. The regression analysis shows the relationship of cargo throughput as dependent variables and the independent variables as number of vessel traffic, turnaround time of the vessel, and number of employees. SPSS Software Version 23.0, was used in the analysis. From the analyses, the table 4.3 above shows the output summary spread sheet of the regression model, it shows that the R-square value is (.987), which means that about 99% shows the percentage of variance in the explanatory variables, demonstrated by the regression model of cargo throughput as the explained variable by the independent variables $(X_1, X_2, \& X_3)$ as number of vessel, turnaround time and number of employees. The adjusted R square with a value of (.973), reveals that about 97% of the cargo throughput are elucidated by the explanatory variables. This value is acceptable because it is reasonable and close to (R squared value). Therefore, it is acceptable. Finally, multiple R with a value of (.993), shows that there is an all-encompassing relationship of (99%), between the dependent variable (Y_1) and the independent variables $(X_1, X_2, \text{and } X_3)$.

The (t values) presented in the table 5, are the ratio of coefficients to standard error and show how significant each variable is. The variable number of vessel traffic was positive, with high significance levels, (values at -4.354). While, turnaround time and number of employee coefficients with (values 0.605 and 0.500), indicates high level of significance with positive coefficients, which infer increase in operational performance.

Tab. 5 *Coefficients* [a]

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1(Constant)	-440945.066	293999.567		-1.500	0.231	-1376582.902	494692.769
Ship_T	-629.245	144.532	-0.463	-4.354	0.022	-1089.210	-169.280
Turn_AT	331305.301	58326.342	0.605	5.680	0.011	145684.850	516925.751
No_Emp	2636.042	367.706	0.500	7.169	0.006	1465.836	3806.248

[a] *Dependent Variable: Cargo_T*

The table 5 above shows the elasticity of independent variables (number of employees, turnaround time and ship traffic) are explained. The elasticity of the β_1 (number of ship

traffic) result is approximately (-0.463), implying that the elasticity of variable to the intercept is inelastic. It means that if the β_1 (number of ship traffic) increases by (10%) dependent variable will increase by (-(-0.46%). The elasticity of the β_2 (turnaround time) result is approximately (0.605), implying that the elasticity of variable to the intercept is elastic since β_2 value is positive. It means that if the β_2 (turnaround time) increases by (10%), dependent variable will increase by (61%). The elasticity of the β_3 (number of employees) result is approximately (0.500), implying that the elasticity of variable to the intercept is elastic. It means that if the β_3 (number of employees) increases by (10%) dependent variable will increase by (50%). Moreso, [30] opined that the increase any of variables used for dependent and independent to run regression analysis shows the relationship and the increase in elasticity and the inelastic limit of the independent variables towards its dependent variable.

2.2 Hypothesis Test

To test hypothesis from regression model, a parametric model was used to ascertain if the parameters used are notable on the dependent variable or not. If the p-value is < 0.05, the null hypothesis is rejected, and the alternative hypothesis is accepted.

H₁: There is no statistical significant relationship between cargo throughput and number of vessel traffic, turnaround time, and number of employees. Table 6 below shows that the P-values calculated is equal to 0.003. Since the p value calculated is less than the tabulated at alpha 0.05 significant, therefore alternative hypothesis is accepted, which means that there is a statistical significant relationship between cargo throughput and number of vessel traffic, turnaround time and number of employees of the seaport operational performance. Furthermore, there is a positively noteworthy relationship between cargo throughput and the independent variables (number of vessel traffic, turnaround time, and number of employees) of the seaport since p-value $< 0.05\%$ alpha level. This implies that the higher cargo throughput operations, the higher number of vessel traffic, thereby increases seaport operational performance [27, 30]. Nwanosike, et al., and Nwanke et al., have stated that operational performance of container ports is the measurement of how productivity and efficiency of the seaports are rated based on the input and output variable estimation [26, 27].

***Tab. 6** Hypothesis Test result using ANOVA*

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	7096.00	3	2365.00	73.268	0.003[b]
	Residual	9685.00	3	3229.00		
	Total	7193.00	6			

[a] *Dependent Variable: Cargo_T*
[b] *Predictors: (Constant), No_Emp, Ship_T, Turn_AT*

3 CONCLUSION

In conclusion, the result from the analysis shows the operational level of Calabar port in terms of operational performance based on their output model summary and hypothesis testing. The output summary shows that Calabar port has an operational performances value of R square 99%. This means that there is high port calling of vessels and effective operational performance at Calabar port, which means that Calabar port is operating at

optimal and efficient production in terms of cargo throughput and other output services. This is due to the Calabar Free Trade Zone and the Calabar port is also a Free Port, therefore making operators and the companies in the Calabar Free Trade Zone and the eastern hinterland to use the port. Moreso, shippers from some part of North-East and South-East also use the seaport because of its high turnaround time and productivity, there is no delay and congestion at the port. Finally, policy implications were made from the results on how to improve the port. The port management need to increase their turnaround time and cargo services by dredging the Calabar River channel so as to increase more vessel traffic and as well improve their port cargo handling equipment to improve the cargo handling services.

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