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ASSESSMENT OF FACTORS INFLUENCING AND INHIBITING CONTAINERIZED FREIGHT FLOW IN NIGERIAN SHIPPING LOGISTICS

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Abstract

The choice of transportation is invariably based on distance, time taken, and cost of reaching each destination by different modes of transport. The distance is also considered from the speed perspective and movement time; while the volume of carriage and flexibility of mode is also important factors in freight flow. However, shipping logistics can be influenced by the port processing speed, number of vehicles (trucks and trailers) at the port, rail and road networks. Shippers tend to assess all aforementioned factors in selection and processes of shipping logistics. Therefore, this paper assessed factors influencing and inhibiting freight flow in Nigerian shipping logistic with data collected from seven out of eight ICD concessionaires cum logistics companies using multiple regression analysis. Results from the analysis revealed that, number of vehicles loading at seaports and inadequacy of road network are not statistically significant. Timeliness in movement, volume of carriage, flexibility of mode and speed of vehicle

are considered by shippers in modal choice. Therefore, there is need for revitalization of rail transport and port processing activities to enhance efficient Nigerian shipping logistics freight flow.

Keywords: Transport, Rail, Road, Logistics, Influencing, Inhibiting, Factors

INTRODUCTION

The key element in logistics chain is transportation system which joins separate activities together. Transportation occupies one-third of the amount in logistics cost and transportation systems influences the performance of logistics systems greatly –NCPDM (1982; Chang, 1988). Historically, Nigerian shipping logistics has been moving materials and products through rail and road networks.Shipping logistics can be influenced by the port processing speed, number of vehicles at the port, rail and road networks. Douglas and Howard (1979) described assessing logistics as an effective logistics system that ensures delivery of the right products and services to the right customers at the right time while minimizing cost and rewarding all participants based on value added to the supply chain. The components he said are: storage, transportation, centres, distribution and e-commerce.

Shipping logistics is increasingly witnessing applications of series of approach to solve global supply chain and myriads of shipping logistics problems. Ports are particularly affected by ever increasing container volumes as their operational capability becomes highly constrained. Increase in container volumes causes increased pressure on entire logistics network resulting into congestion, high dwell time and higher logistics costs (Japan International Cooperation Agency, 2009; Arvis, 2010; UNCTAD, 2009). In light of these constraints, ports have embarked on implementation of inland container depots (ICDs) as operational and capacity enhancement strategy for easing pressure at congested maritime terminals (Haralambides and Gujar, 2011).

Brooks (1984) found that the determinants, which affect the shippers' choice of a carrier with reference to Canadian exporters, are cost of service, frequency, reputation and transit time. Whyte (1993) indicated that the decisions of the shippers were relied on the port, delivery time, contract and reliability. Studies revealed that speed and reliability were the most important service factors for shippers, followed by freight rate, loss and damage. The choice of the integrated logistics companies for the firms was shown to depend not only on the sensitivity of industry competition, environment changes, but also on the shipping charges, delivery ability, accuracy, and response ability. Chiu (1996) examined the logistics performance of liner shipping in Taiwan from both shippers' and carriers' points of view. The results of the study showed that

the most important service attributes to shippers were prompt response from carrier to any problem, transit time reliability, documentation services, notice of delay, and assistance of loss/damage claims from carrier.

Invariably, timely delivery is relative to speed. In speeding however, attention must be given to safety. If consideration is given to speed to achieve timely delivery and consideration is not given to safe- speed, it may result in accident that can reverse the whole logistics objectives. Kaplan and Cooper (1982) and others argued that logistics system should capture all relevant areas in its assessment. They described performance evaluation as a way to review organizations both their financial and non-financial objectives.

Nigerian roads especially relating to this study linking ports and hinterland sometimes are full of pot holes that are responsible for breakage of vehicles along the major roads resulting to incessant traffic jams, congestion and environmental pollution. The road seems to contribute to often break-down of vehicles even with proper maintenance. However, road transportation charges are more than rail transportation charges (Ubogu, 2011). Cost of fuel accounts for more than 50 percent of the running cost of truck, heavy labour charges engaged for unloading, road traffic congestion because of bad road conditions, i.e. loss of time and money contributes to higher transportation charges.

The rail is basically a long hauler and slow mover of raw materials (coal, iron ore, etc) and of low-valued manufactured products (food, paper and wood products) and prefers to move shipment sizes of at least a full carload. This mode of transport is most suitable for long distance bulk goods. Rail transport is not flexible and cannot offer door to door services. Furthermore, the cost of putting rail tracks across the places in Nigeria is another major constraint. Rail transport requires special equipment and can encounter sudden delay as a result of problems arising from erosion that might have thwarted the rail tracks. Odeleye (2000) reported that the Nigerian railway network comprises 3,505 kilometers of narrow gauge (1.067m), single track running parallel through north-west to south-west and from south-east to north-east of the country. It is in the light of these that the paper attempts to analyse and subsequently articulate variables that are likely to challenge the flow of containerized fright in Nigerian shipping logistics with a view to providing possible solutions to these problems through harnessing various potentials that are available for these flow of freight, but that have remained untapped and unexplored.

LITERATURE REVIEW

The major function of transport system of any country is the efficient delivery of goods in the fastest and cheapest way possible. Nigeria has its coastline on onl**y** one side of the quadrangle. It also has deep rich hinterland producing most of the export products and consuming most of

the import items. The ocean and river ports (developed and potential) are (a) Lagos (Tin Can Island and Apapa), Port Harcourt, Bonny, Calabar, Sapele, Warri, Burukutu,Koko *(developed*) (b) Oron, Badagry, Epe, Opobo, Eket, Forcados, Akassa, Brass, NunIbeno and Ikang *(potential*). Prominent and common to all the weak logistics system, deriving from poor infrastructural base, management inertia and incremental but uncoordinated and unimpressive improvement in logistics are directly specific to Nigeria (Ballou, 1998). Although, it is still estimated that some 100,000 tonnes of cargo is still transported along the Bight of Benin where waterways are the only available mode of transportation, the inland share in transport market is statistically insignificant (Botha and Filani, 2006).By not using other modes of transport, Nigerians are been deprived of the comfortability, accessibility, and cost-effectiveness as a result of monopolistic nature of logistics system occasioned by road transport.

Assessment Nigerian rail-road network

Obafemi (2011) conducted a survey that show case that the state of Nigerian roads (the infrastructure in transportation network) remains poor for a number of reasons such as faulty designs, lack of drainage and very thin coatings that were easily washed away, excessive use of the road network given the under-developed nature of waterways and railways among others. Most railway lines in developed countries have dual tracks. This is not the case in Nigeria. In Nigeria, dual tracks are found only at the railway stations. For both forward and reverse logistics, Nigerian rail network is only on single lane. Normally, the spatial distance between two rail stations should not be more than 15km. When stations are few distances apart, it makes it easy for trains coming from opposite directions to give each other right of way (shunting) (Okoko,2006). In Nigeria, the stations are widely scattered, and because they are mostly single-track rails, one train must wait at a station for a long time for the arrival of the other, before it can proceed on its journey.

Nigerian railway is still using the narrow gauge of 3ft6inches (106.68 or approx.107cm) instead of the standard gage of $4ft8^{1/2}$ inches (143cm) or the broad gauge of 5ft3 inches (106cm). The narrow gauge does not give any room for speed and cannot accommodate modern coaches or wagons. The signaling equipment for the rail transport is very expensive, and the one in use now in Nigeria is obsolete (Okoko, 2006). The reliance on road transport and lack of operational port-rail links in Nigeria results in severe congestion and its negative multiplier effect is crucial and may be low productivity (Botha and Filani, 2006).

Concept of ICD and performance evaluation of shipping logistics

Having realize the importance of depot for onward movement and effective distribution of goods throughout the country, Nigeria proposed the establishment of inland container deports (ICDs) across strategically located points so as to serve the entire six (geopolitical zones) of the nation. The main benefit offered by the logistics concept lies in the fact that it offers an integrated approach to business where total costs and cost trade-offs analyses are used taking all logistics factors into account. Common trade-off analyses include transport against inventory costs, production against transport costs, and production against inventory costs. In analyzing shipping logistics operations' performance (Adelayo, 2007) noted that; performance evaluation can be examined based on timely operation, quality of service evaluation, comparison and statistical analysis/optimization methods.

A carrier's optimal port call structure is not only a function of voyage distance, steaming time, or port time, but also a complicated interplay of these operational factors with shippers' needs for transit time, service frequency, special equipment, or other service elements. When there is no congestion, the berth-access time and cargo handling period at berth are the unavoidable components of ship's port time, the size of which in relation to volume of cargo lift per ship will determine the total number of ships needed to carry the traffic of a port. Unfortunately, after independence there were no major track extensions made by the government in the past five decades. Basically, the existing network is the colonial relics Nigeria inherited from the colonial administration. The total abandonment of the railway system by successive governments had plunged the railway system in Nigeria into a state of comatose. After twelve years of independence, the Nigerian Railway Corporation began recording financial losses, a trend that has not only continued but has increased in enormity.

Logistics management requires all components of the intermodal freight transportation process to be reliable, offer connectivity with other modes and have the flexibility to make changes when alternative business opportunity develop, while the freight is still in transit (Somuyiwa,2008).

RESEARCH METHODOLOGY

The Study Area

Nigeria is a country which lies between Latitude 40N to 140N of the equator and Longitude 30E and 150E of the Greenwich Meridian (Filani, 1995). The country is located in West Africa and shares land borders with the Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north. Road –rail network data with the aid of structured questionnaires from ICD concessionaires. Extant literature recorded that there are over 160 shipping companies in

Nigeria. However, the Nigerian Shipper's Council identified only seven among the concessionaires to operate ICDs and CFS in Nigeria.

Table 1: Population of Study

Name of the logistics /shipping company	No of operational staff relating to study only
Dala Inland Container Ltd	25
Catamaran Logistics Ltd	56
East Gate Inland Containers Ltd	28
Duncan Maritime Ventures Ltd	55
Central Inland Terminal Ltd	43
Equitorial Marine and Gas Ltd	71
Migfo Nigeria Ltd	44
Duku (Gombe)	No preferred bidder yet
Ifo	No bidder yet
Kaduna	No bidder yet
Total	322

The sample size for the study will be determined following Yamane (1967).

$$n = \frac{N}{1+N(e)^2}$$

Where,

n = Sample size; N = Population size; e = Level of Significance (at 5%).

$n = 322/1+322\ (0.05)^2 = 177$

From the 177 questionnaires distributed 104 were returned.

Table 2: Sample Size

Preferred bidder	**Sample size/technique**
Dala Inland Container Ltd	**177/322 x 25= 14**
Catamaran Logistics Ltd	**177/322 x56 =30**
East Gate Inland Containers Ltd	**177/322 x28= 15**
Duncan Maritime Ventures Ltd	**177/322 x 55=30**
Central Inland Terminal Ltd	**177/322 x43= 24**
Equitorial Marine and Gas Ltd	**177/322 x71= 39**
Migfo Nigeria Ltd	**177/322 x44= 24**
No preferred bidder yet	**Nill**
No bidder yet	**Nill**
No bidder yet	**Nill**
Total	**177**

The followings formed the parameters:

$Y = a_0 + b_1x_1 + b_2x_2 + b_3x_3…….. b_nx_{n+} e$

Where:

Y = Dependent Variables

$a_{0 =}$ Slope/Intercept

b_1-b_n= Regression coefficients

x_1-x_n = Independent variables

e= error term or residuals

Y= Shipping logistics modal choice

a_o = slope or intercept

The hypotheses formulated include:

Y_1= Shipping logistics

X1= number of vehicles (truck/trailers)

X2= Port processing (number of cleared container per/day)

X3= Inadequate road network

X4= Inadequate rail network

Similarly, hypothesis that factors that inhibit connectivity and accessibility modal choice do not have significant effect on shipping logistics was examined and results were discussed in the subsequent section.

Y_2=Shipping logistics modal choice

X_1=movement time of the vehicle

X_2= Speed of the vehicle

X_3= Volume of carriage

X_4= Flexibility of the mode of transport

RESULTS AND DISCUSSION

Road and rail modes of transport are the notable modes for the evacuation of goods from the selected Nigerian seaports. However, decision to use these available modes of transport can be influenced by number of vehicles available for loading at the seaports, the port processing (containers cleared per/day), adequacy of road and road networks. To this end, the following results were obtained:

Table 3: Summary of Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.673[a]	.453	.431	.85034

Table 4: Factors influencing the use of rail-road transport

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.886	.568		10.353	.000
	Number of vehicles	.057	.080	.066	.714	.477
	Port processing	-.414	.060	-.549	-6.929	.000
	Inadequate Road network	.103	.089	.103	1.164	.247
	Inadequate rail network	-.260	.087	-.246	-2.987	.004

a. Dependent Variable: Factors influencing the use of rail-road

Table 5: ANOVAb

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	59.252	4	14.813	20.486	.000[a]
	Residual	71.584	99	.723		
	Total	130.837	103			

a. Predictors: (Constant), Inadequate rail network, Port processing, Inadequate Road network, Number of vehicles

b. Dependent Variable: Factors influencing the use of rail-road

The regression equation:

Shipping logistics = 5.89 - 0. $41X_2$ -$0.26X_4$

From the Tables 4, R value of 0.67 is the value that all independent variables combined relationships had with the dependent variable. R^2 is 0.43 and this implies that 43 percent of the variation on performance is explained by the variables (Inadequate rail network, Port processing,)considered at ($p<0.05$). While number of vehicles and inadequate road network are not statistically significant. These are not significant because the significant values 0.477 and 0.247 are greater than 0.05 for number of vehicles and inadequate road network respectively.

From table 5, a unit decrease in in port processing will cause a decrease of about -0.41 in factors influencing the use of rail-road in shipping logistics at $p<0.05$. The negative sign is the cause of the decrease. Also, a unit decrease inadequacy of rail network caused 0.046 decrease in factors influencing the use of rail-road on the at $p< 0.05$. F –value is 20.5 which revealed the

prediction of the model. The analysis has been able to reveal that, the rail network in Nigeria for shipping logistics operation is not enough. Conversely, the road network is adequate and the congestion experienced at major Nigerian seaports may be attributed to inability to use other modes of transport so as to enhance intermodalism.

Assessment of Modal Choice in Shipping Logistics

In order to access and connect to the inland (dry) ports; shippers considered certain factors especially with respect to selection of a mode of transport. These factors are: movement time of the vehicle, speed of the vehicle, volume of carriage, and flexibility of modal choice. Multiple regression analysis was used to examine the significance of relationships between the dependent and independent variables.

Table 6: Summary of the model (b)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.443[a]	.196	.164	1.10304

a. Predictors: (Constant), Flexibility of mode of Transport, Movement time of vehicle, Volume of Carriage, Speed of vehicle

Table 7: Factors inhibiting connectivity and accessibility modal choice in shipping logistics

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	.377	1.301		.290	.003
	Movement time of vehicle	.426	.146	.273	2.928	.004
	Speed of vehicle	-.201	.127	-.146	-1.574	.011
	Volume of Carriage	.368	.113	.301	3.262	.002
	Flexibility of mode of Transport	.262	.165	.145	1.584	.013

a. Dependent Variable: factors inhibiting connectivity and accessibility modal choice

The equation = $0.377 + 0.43_{X1} - 0.2_{X2} + 0.37_{X3} + 0.26_{X4}$

Table 8: Analysis of variance/ ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	29.384	4	7.346	6.038	.000[a]
	Residual	120.453	99	1.217		
	Total	149.837	103			

a. Predictors: (Constant), Flexibility of mode of Transport, Movement time of vehicle, Volume of Carriage, Speed of vehicle

b. Dependent Variable: factors inhibiting connectivity and accessibility modal choice

R is 0.443 which is the combined effect of the independent variables (Flexibility of mode of Transport, Movement time of vehicle, Volume of Carriage, Speed of vehicle) on the dependent variable. R^2 is 0.196. This implies that 19.6 percent of the variance in factors inhibiting connectivity and accessibility modal choice could be predicted from the independent variables attributed to, accounted for and explained by variance in the set of predicator variable taken as a whole. The F-ratio of 6.038 at $P<0.05$ significant levels show that all the regression parameters are significantly different from zero.

From table 7 above, the coefficient 0.426 represents the movement time of vehicle as a factor inhibiting connectivity and accessibility modal choice. That is, one unit increase in movement time of vehicle will lead to 0.426 increase in factors inhibiting connectivity and accessibility modal choice. Therefore it is significant at $p <0.05$ level of significance. Although the speed of vehicle's coefficient is negative -0.2, it is still significant at $p<0.05$ level of significance. This invariably means that a unit decrease in speed of the vehicle will lead to 0.2 decrease in factors inhibiting connectivity and accessibility modal choice. In other words; the more speedy a particular mode of transport in shipping logistics, the more the connectivity and accessibility. The volume of carriage relationship with the dependent variable is significant at $p<0.05$. A unit increase in the volume of carriage depicts about 0.368 increase in factors inhibiting connectivity and accessibility modal choice. The volume of carriage is a strong factor in selecting mode of transport. Moreover, the flexibility of mode of transport is a factor and is significant among the factors inhibiting connectivity and accessibility modal choice at $p<0.05$. A unit increase in flexibility of mode of transport will lead to 0.262 increase in factors inhibiting connectivity and accessibility modal choice. The major reason why road is still preferable to rail mode of transport may be attributed to its flexibility. The more flexible a mode of transport; the more the mode is connected and accessible. In modal choice considerations in shipping logistics, the aforementioned factors are critical and need to be carefully looked into by rail and road carriers.

CONCLUSION AND RECOMMENDATIONS

The freight flow in Nigerian shipping logistics requires the functionality of all available modes of transport. The road network as indicated from the outcome of this research is not statistically significant in shipping logistics operations. It therefore means that, the congestion experienced at Nigerian major seaports may not be accruable to lack or inadequacy of road network. Rather, it may be attributed to inability to make and maximize the use rail transport in Nigerian shipping logistics operations. Also, number of vehicles may not be considered as one of the factors influencing the use of rail-road networks in shipping logistics.

However, one of the prominent issues that may not facilitate the prompt utilization of the two networks (rail and road) is the processing at the ports of cargo clearance. Although, this has been reported by some researchers, but the problem has not been solved absolutely. Secondly, the rail network in Nigeria is just a single track for both onward and reverse logistics. This invariably will cause delay as train will have to wait for one another in the cause of movement. To make the matter worst is the fact that, the rail tracks are not evenly and well connected for effective shipping logistics operations. Having the tracks from South to North is not only a problem but making it evenly constructed across the eastern part of Nigeria as well as North – West is highly important. The factors that inhibit connectivity and accessibility modal choice had been seen as the volume of carriage and speed of vehicle as very important. Therefore, the peculiarity of characteristics of available modes of transport should be put to use in order to enhance intermodalism. This implies that as the modal infrastructures are developed, connecting facilities should also be provided to cater for inter-modal transfers at major terminal points. These interface points must be equipped with adequate cargo transfer equipment. The effective functioning of the ICDs would reduce to a reasonable level some of the inefficiencies associated with transporting goods to hinterland locations such as the exorbitant freight costs, traffic delays caused by the piece-meal loading, very slow movements and en-route breakdowns as well as armed robbery attack (Oni, 2000). To this end, the paper is seeking the intervention of government at various levels not only to construct functional rail networks but also to make use of the available ones in shipping logistics by ensuring that rail transport is efficient in moving materials and products both for onward and reverse shipping logistics operations. However, it is imperative to state that the major and general findings of the findings are likely to be limited by ineffective planning, inadequate political will, non pragmatic and non holistic policies and non proactive public service. If all these are well and adequately approached, through intermodalism, it would enhance the flow of containerized freight in the country, Nigeria.

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