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Analysis of Constraints against Efficiency of Seaport-hinterland Logistics in Nigeria

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Abstract

Having realized that most Nigerian seaports are congested and the problem of moving goods have been difficult, the Federal Government through Bureau of Public Enterprises and Nigerian Shippers' Council were mandated to identify Inland Container Depots (ICDs) and Container Freight Stations (CFSs) across the country with connectivity to rail transport. Since 2004 to date, these have mostly not been functioning. This paper therefore examined the constraints and possible factors responsible. The Nigerian Ports Authority, Road Haulage Association, Terminal Operators, selected Shipping companies were used as respondents. 34.1% (253) from the population of 743 respondents were sampled with the use of Cochran formula and stratified random sampling technique. Shaphiro Test and multiple regression were used to analyze the constraints against the use of ICDs and CFSs. Principal Component Analysis was used to extract the major factors hindering port-hinterland logistics in Nigeria. It was observed that 50% of general logistics constraints emanated from lack of efficient rail system, enforcement and finance combined. Extracted causative factors against port-hinterland movements of goods are: inadequate terminal capacity, parking and inadequacy of cargo handling facilities. The research concluded that both general constraints and causative factors are to be looked into with stringent policy enforcement.

Keywords

hinterland, logistics, seaport, constraint, Nigeria

1 Introduction

Nigeria as a littoral state is connected with the rest of the world in terms of import and export significantly through shipping with the interface of seaports and terminals. The demand for foreign goods like machinery, vehicles, furniture, pharmaceutical products among other commodities have increasingly been imported into Nigeria over the years (Somuyiwa et al., 2021). Since the year 2000, the Nigerian seaport congestion became evident with attendant challenges of delay, sharp practices which was to be solved with concept of Seaport reforms and concessioning (Ndikom, 2006; Somuyiwa et al., 2015). The Nigerian seaports were initially classified as Western and Eastern ports. The Western comprises of Tin Can and Apapa seaports and the Eastern ports are Onne, Bonny, Sapele, Warri, Koko and Burutu seaports. There are other ports like Oron port, Epe, Opobo, Eket, Forcados, Akassa, Brass and Ikang that are potentially not fully developed. In order to foster rapid development and decongest seaports in Nigeria, the federal Government through the Bureau of Public Enterprises and Nigerian Shippers' Council established Inland Container Depots (ICDs) and container Freight Stations (CFS) (Somuyiwa et al., 2015). The ICDs are far away from the port and mostly referred to as dry ports. The CFSs are usually closer to the seaport or harbour for easy clearance or warehousing of cargoes. In spite of strategies to enhance logistics efficiency, seaport logistics processes are yet to meet the speculated rapid cargo delivery within 24 hours.

In the research conducted by Aprilianty and Evander (2017), they realized that inefficient operation at the seaports usually occur because of delay to start on time, delays due to meal break, delay arising from the damage to equipment, clearance delay, queue of incoming vessels, delay as a result of ship to ship transfer and lack of proper scheduling. Alavi et al. (2018) expressed that integration of port logistics is a key factor to realizing maritime logistics efficiency. According to Yabe (1991) ports do not only function as junctions of marine and

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land transportation but also as nucleus areas for industrial activities and cities since ancient times. From international to local, one of the propositions to ease the menace of maritime logistics now is the involvement of private investors for the building of another seaport at Lekki and or Badagry in Lagos State, Ibeno or Ibaka in Akwa Ibom, Warri in Delta State and Cross Rivers States respectively. While it was observed that western seaports are challenged by congestion because of the known fact that ship arrival rate, clearance and logistics evacuation both within and outside the ports are inefficient, the eastern ports often experience challenges of insecurity, robbery, piracy and other forms of unrest or security issues.

Moreover, another critical issue concerning Nigeria's maritime logistics is in the area of performance based measures to assess the level of our output in products exportation across the shores and the importation traffic in a continuous manner in order to propel and project the national resources for a better economy. Burns (2015) expressed that, ports' efficiency is usually measured by time, safety and value for money; what is critical for modern port managers is the optimum combination and usage of their factors of production so as to serve the global supply chain. Hence, port capacity planning used to focus on port efficiency and optimum utilization regarding the berth occupancy, vessel traffic control, and cargo handling among others. According to Anagor-Ewuzie (2022) the Federal government of Nigeria has observed that inability to make ICDs port of origin and destinations contributes to the logistics problems in Nigeria. Fig. 1 shows the locations of some of the seaports and Inland Container Depots with Container Freight Stations in Nigeria. The rail track network in Nigeria is also depicted in Fig. 1. All seaports identified are marked with a blue triangle. Both Apapa and Tin Can seaports are represented in one location in Lagos State as well as Onne and Port Harcourt Seaports in Rivers State. Container Freight Stations are represented with yellow circles and Inland Container Depots with red rectangles.

Osadume and University (2020) expressed that; the implication of inefficient logistics will result in poor economic performance. The questions raised in this research are what are the constraints against the implementation of ICDs and CFSs linking major Nigerian seaports? Secondly, what are the causative factors impeding seaport-hinterland logistics in Nigeria. From these research questions, the hypotheses formulated for this research are: $H0_1$: There are no significant constraints against implementation of ICDs and CFS linking major

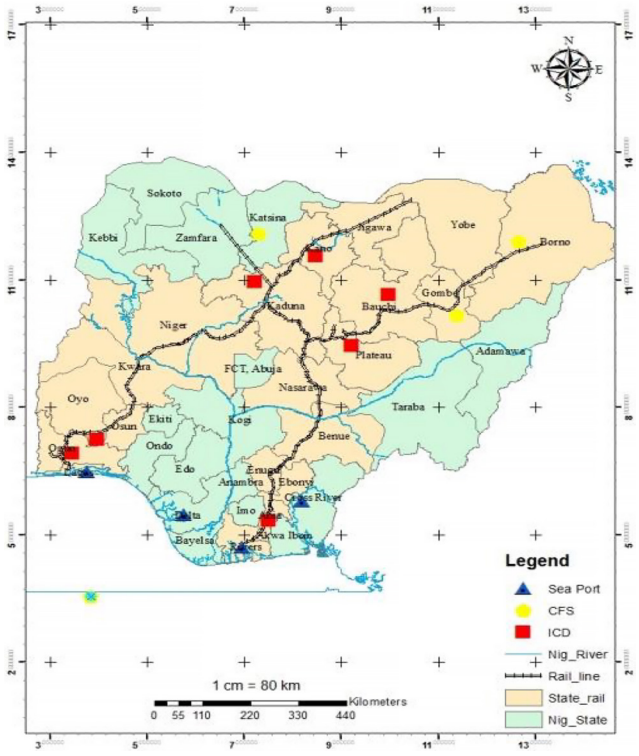

Fig. 1 Nigerian major seaports and rail network
Source: adapted from Adepoju (2015)

Nigerian seaports. Secondly, $H0_2$: The causative factors are not significant enough to impede seaport-hinterland logistics in Nigeria. The purpose of this research is to find the reasons for not utilizing the established ICDs and CFSs and to investigate the causative factors of port-hinterland logistics challenges generally across Nigerian major seaports.

2 Theoretical underpinnings

2.1 Logistics constraint theory

The Logistic theory of constraint explains the bottlenecks or impediments to achieving set goals of an efficient logistics network. Following Goldratt and Cox (1992) concept of theory of constraint and its application to Seaport and hinterland logistics connotes that in a complex system of transport and multimodal logistics operations, there aremany functions and operations that will overlap. In other words, conflict of interest and divergent operations may cause a setback to the achievement of set goals. In order to differentiate the concept of effectiveness and efficiency Ericson (2004) used dualism and duality to develop a construct which unambiguously depicts that the word efficiency is attaining towards the goals opposing inefficiency and similarly effectiveness is opposition to ineffectiveness. It is clearly true that efficiency and effectiveness are not opposing elements, however; without drawing a line of

similarity, the attainment of constraint elimination by efficiency is way higher compared to effectiveness. According to Šukalová and Ceniga (2015) the application of theory of constraints can help streamline activities of fifteen and more companies for greater efficiency. Somuyiwa et al. (2021) explained that heuristics and meta-heuristic models can be developed to solve a single problem or multiple problems respectively. They opined that optimal logistics solution may not be achieved by removing logistics constraints but it is a good attempt to do so even with the presence of conflicting objectives. Adepoju (2021) observed that constraints in Nigerian maritime logistics can be linked to the use of manual system of operations in the 21st century. According to Somuyiwa et al. (2015) the connectivity of rail network to the ICD centres is very crucial to the port logistics in Nigeria. In the assessment of constraints as provided by Tongzon and Oum (2007), they espoused on the need for infrastructure to relieve the queue experienced at the seaports. Infrastructure must not be in terms of quantity but also of quality of cranes, container terminal, tug boat, information facilities and inter-modal transport. Limited access to port information and arrival of vessels with non-dynamic cargo clearance processing are the bane of maritime logistics. Adepoju (2021) citing Fujita and Mori (1996) noted that the main problem of the ports is the uncontrolled industrialization right from the beginning of port development. They maintained that, Asian countries like Indonesia, the Philippines, Thailand even Shanghai, Hong Kong and Singapore had experienced a disproportionate share of population due to location of seaports. The case of Apapa is worsened as it houses major oil depots, independent oil marketers and extortions by enforcement agencies (Guardian, 2020). Ndikom (2006) expressed concerns over parking space for both terminal operators and port authority in Nigeria. The movement of loaded and empty containers in and out of port complexes can frustrate anyone who is engaged in importation mainly at Apapa ports in Nigeria. The problem of yard productivity lies in freeing the spaces for confiscated cargoes at the ports. Hadiza (2018), the former Managing Director of Nigerian Ports Authority (NPA) noted that, off-peak (night) clearance was initially introduced to ease maritime logistics at Lagos Ports but the cargo owners became skeptical because of safety of their lives and properties. There are no facilities to store cargo and the handling equipment are few. In an attempt to find lasting solution to the problem of maritime logistics, again; the ETO programme has been innovatively developed to have seven truck parks at different designated areas and from which trucks are to be called into the port on schedule (Awojulugbe, 2021). ETO has been seen as a method that will remove human intervention in the process of port logistics operation. This is still on-going solution to the problem as the presidential task force to enforce decongestion of port could not yield a positive result. There seems to be no proper coordination of logistics of maritime transport in Nigeria as 90% of cargoes to be shared between rail and road transport are carried by trucks. Berg and Hauer (2015) maintained that, for efficiency of maritime logistics to be achieved; technology and containers with radio frequency identification with automated solutions based on internet of things must be activated. According to Burns (2015), port efficiency is critical to realizing safe, secure, cost effective and eco-friendly practices at the ports. Many activities inter-play at the seaport, for example chandlers, freight forwarders, investors, ship owners, surveyors, brokers with machineries are to bring about economies of scale through containerization and other forms of wet cargo shipments. Privatization was seen as the agent of productive and rapid transit in order to facilitate quick delivery and order shipping logistics fulfillments. The industrial locations of tank firms in Apapa over the years had been noticed to be a major barrier to traffic flow. Regrettably, Apapa and Tin Can Island ports do not have through traffic and traffic diversions as it also houses commercial, residential and industrial land uses (Adepoju, 2021). In spite of the dedication of certain port for RoRo, Container and wet cargoes; the presence of terminal operators at Western seaports is, to an extent, a problem for traffic flow. There are now contradictory objectives in terms of enhancing productivity through concessioning and achieving easy traffic flow without these terminal operators and tank firms (Adepoju, 2021). These are some of the constraints against the efficiency of port-hinterland logistics in Nigeria. According to Lee, Tongzon and Kim (2016) to remove or enhance the real issues for port logistics is in the area of cost and time for logistics optimization. Theory of Constraint provided steps to solving constraint problem by identifying the logistics system constraints (this can be weakest link in the supply chain, the policy or physical infrastructure). Secondly, we must decide on how to explore and eliminate constraints in the logistics operations. This can be in form of removal of down times or any bottlenecks across the logistics chain process. The third step is to provide settings to adjust all the non-constraint elements with the new reality. The fourth step is to upgrade

or elevate the system after the successful introduction of step two and three. Kapustina et al. (2017) illustrates theory of constraints with five steps following the same concept by the Digital Supply Chain Insight concept as shown in Fig. 2: Identification of the constraints means careful examination to understand what the current situation is and what is causing constraint in the logistics process at the port, among workers, the process, procedure, the capacity, etc. Exploiting constraint means going further to know some other causes of the constraints like strike, legal action or policy, equipment with overview of external and internal factors and other non-value adding activities. The next is shrinking the process to the available capacity of the existing constraint and the fourth step to optimize the opportunities with technology, competent workforce, automation, capacity increase, capital investment in intermodal among others. This process can be repeated as the last stage. It was used as Drum-buffer rope concept to eliminate constraints Goldratt with perspectives from corporate, production and machine levels.

2.2 Transportation network theory

Transportation connects and links places, people and services. The network and the flow of movement in the network is determined by the number of lanes, traffic intensity, journey length, average travel time, speed of the vehicle, peak hour and capacity of the transport infrastructure (Potts and Oliver, 1972; Akanmu and Agboola, 2015). Transportation and logistics require planning processes for efficient system of operations. This includes forecasting future expansion to work against any form of restriction. Long standing modelling tools like traffic assignment model, distribution model, trip generation model and modal split models are all models employed in transportation network flow and analysis. Application of Kirchhoff flow theory in transportation symbolises the representation of transport network with graphs and the flow as

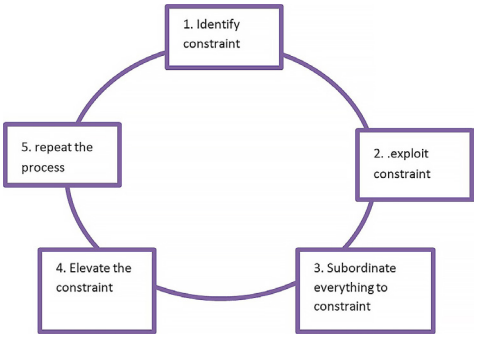

Fig. 2 Digital Supply Chain Insight concept (Al Amin et al., 2020)

the movement of vehicles per time. This time can be weeks, months or years. Naturally, there is an impedance to flow of movement where there is a river or water body. The restriction on the network can be increased with artificial barricades arising from demand for charges to pass, intersection, bad road network, increased clearing charges, long documentation procedure and lack of equipment. According to Lowe (2005) the introduction of transport in which each mode can do what it does best enhances flow and it is the hallmark of the concept of intermodal transport.

3 Methodology

Since 2004 when the Inland Container Depots and Container Freight Stations have been strategically located across different geographical locations in Nigeria to facilitate the decongestion of Nigerian major seaports, they have not been fully operational. Therefore, this research methodologically examined the constraints from policy implementation constraints perspective considering all constraints in translog production function for service operations in maritime logistics explained by Eq. (1):

$$y = \alpha + \alpha 1p + \beta 1e + \gamma 1h + d1f + \partial 1r + \sigma 1l. \tag{1}$$

Introducing Exogenous parameter and constraints are introduced into the logistics function:

$$\begin{aligned} y = {} & \alpha + \alpha 1p + \beta 1e + \gamma 1h + d1f + \partial 1r + \sigma 1l \\ & + \alpha 2p2 + \beta 2e2 + \gamma 2h2 + d2f2 + \partial 2r2 + \sigma 2l2 \\ & + \in 1p + \in 1e + \in 1h + \in 1f + \in 1r + \in 1l. \end{aligned} \tag{2}$$

In Eq. (2) for multiple regression, in form of movement time as is constrained by p = political constraint (unwillingness by government to solve logistics problem, l = legal constraint (arising from constitution, legal suit or lawful order) or, r = rail operational constraint, h = human factor constraint (e.g. strike, indolence, etc.), financial constraint (to execute the necessary projects for smooth logistics operations), enforcement constraint (ability to enforce the law). Secondly, Exploratory Principal Component Analysis (PCA) was used to extract latent variables that are most relevant among the causative factors responsible for seaport-hinterland logistics constraints. This is because (PCA) is a perfect technique for extraction of factors or variables among many as it reduces variables into constructive constructs to form a composite. Shapiro test was performed for normality of the collected data. Agencies involved in the shipping logistics are Nigerian Ports Authority (Apapa, Tin Can Island, Calabar, Onne, Port Harcourt, and Warri), Nigerian Shippers' Council,

Terminal Operators, shipping companies, freight forwarders, Nigerian Custom Service and Road Haulage Association. The targeted population selected from the aforementioned agencies was 743. The sample size from the population was determined with Cochran's formula and stratified random sampling technique. Cochran's formula was used to calculate the sample size.

$$n_0 = \frac{z^2 Pq}{e^2} \tag{3}$$

From Eq. (3), e is called the "margin of error" or desired level of precision. P estimated proportion of the population which has the attributes. The q is $1 - P$.

$$n = \frac{n_0}{1+(n_0-1)/N} \tag{4}$$

Since our confidence level is 95%, we get the Z score by Z values of 1.96 per normal table. Therefore, a 95% confidence level gives us Z values of 1.96, per the normal tables, so we get:

$$n_0 = 1.96^2 \frac{0.5 \times 0.5}{0.5} = 385,$$

by incorporating n_0. The sample size then gives

$$n = \frac{385}{1+(385-1)/743} \times 385/1.52 = 253$$

to the nearest whole number as half a man cannot be sampled. Stratified random sampling technique was used to select the sample from the population. The reason for using this sampling technique is for members of the population within the purview of stakeholders to be captured in the data. Proportionate sample were drawn from the strata. Of the targeted population of 743 253 (34.1%) were sampled with the use of Cochran's formula and stratified random sampling technique. The designed questionnaire has been used to collect data on the constraints against effective port-hinterland logistics system in Nigeria.

4 Factors and relationships

The constraints seemed to be directly proportional to political, legal, cultural, institutional, human, financial and utilization of rail transport, i.e., constraints a α f (political, legal, cultural, rail, institutional, human, financial). In order words, constraints to the use of ICDs and CFSs are functions of Political, Enforcement. Legal, Rail operation, Human and Financial which respectively stands for (political, legal, enforcement, rail, institutional, human, financial). Linear regression model was used to analyze the collected data. Ranking system from collected data was used with the aid of Multiple Regression model to identify the level of significance of the constraints against the use of Inland Container Depots or Container Freight Stations in Nigeria. Ordinal consideration of data from the respondents provided an insight to the result retrieved from the R analysis.

5 Results and discussion

Fig. 3 shows level of significance of the identified constraints factor in the Nigerian maritime logistics system with correlation matrix. The three red stars indicate that rail connection to the ICDs and CFSs is the most critical factor as it is not been used to evacuate cargoes from the seaports with the correlation of almost 1 (0.96). Another critical issue is the enforcement of government policy, with just only one star and very weak correlation to the extent of having –0.13 value as shown above. Financial constraint has a positive value of 0.11 and the legal constraint has a value of –0.11.

The data was tested for normality to validate hypothesis using Shapiro Test with the result shown below. Structure (list(structure(0.100056364606169, .Names = "W"), 5.39311883889821e–32, "Shapiro-Wilk normality test", "resid(linear)"), .Names = *c*("statistic", "*p*.value", "method", "data.name"), class = "htest") Since the *p*-value is <0.05 the null hypothesis is hereby accepted. The null hypothesis here is that: There is no violation of normality test. It must be stated that normality test to validate hypothesis is different from the hypotheses stated for this research, rather this is for the collected data before the analysis could be executed. Table 1 shows the multiple regression values of the relationship between Maritime logistics performance and its constraints with $R^2 = 0.5$. This means that if multiplied by 100, 50% of the constraints in Nigerian maritime

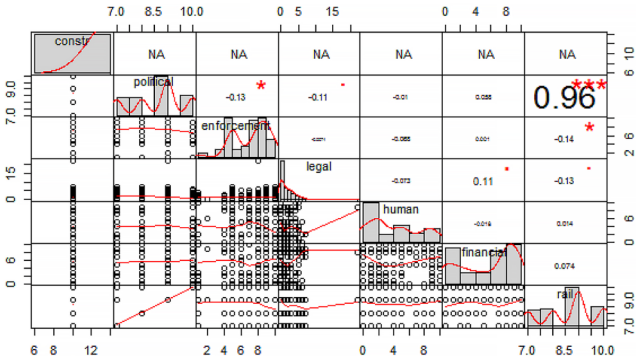

Fig. 3 Regression correlation of constraint factors
Source: output from R-software (CRAN, 2023)

logistics is accounted for by non-functionality of rail transport in evacuation of goods from the seaports, lack or inadequate level of enforcement and weak financial strength. From this finding, the use of rail transport is critical to the optimization of maritime logistics. Without efficient rail transport, the constraints to the use of ICDs and CFSs in Nigeria will continue. More importantly, there is need for proactiveness by the part of government concerning the enforcement of policies relating to maritime logistics in Nigeria. Lip service enforcement or written document without action cannot be said to bring the necessary optimized logistics service. Similarly, all the necessary financial supports must be provided in order to achieve efficient or effective maritime logistics in Nigeria. Since 50% of these constraints revolve around this three major factors, it can be observed that they are to be given priority for us to have efficient and rapid turnover both in terms of social and economic benefits.

5.1 Prediction model

The model identified some constraints clearly extracted from the responses of the respondents. From the linear regression model expressed in Eq. (1), the resultant model indicated that some of the variables are not significant and therefore will not be included as predicting factors for the constraints in ICDs and CFSs usage in Nigeria.

$$y = a + \beta 1e + d1f + \partial 1r + \sigma 1l. \qquad (5)$$

Equation (5) is the outcome of the extraction from predictive model in Eq. (1). This means that, arising from the analysis, the constraint factors are majorly the enforcement (e), financial (f), rail transport (r) and legal (l) matters. However, among these constraint factors, rail transport has been seen to be the most significant followed by weak enforcement, financial strength and legal matters. All these combined as predicted by the model accounted for half of the constraints to the usage of ICDs and CFSs in Nigerian maritime logistics. As depicted by Fig. 1, using rail transport to evacuate goods is the best option to reach all the locations of the ICDs and CFSs. Of course, the predetermined considered factors to identify ICD locations by the Bureau of Public Enterprise and Nigerian Shippers' Council include: guarantee that each geo-political zone will be represented as a point to reach out to all the States under the zone. Secondly, that rail track is connected to these zones for ease of movement. The tendencies to even diffuse rail tracks to different destinations or having a mono rail for ease of movements to terminals, CFSs and ICDs can be initiated. Dedicated lanes in form of Bus Rapid Transport BRT system for rail transport across congested areas, even if it warrants surface transport with maximum level of safety guarantee, is possible. In order to find out the causes of port-hinterland logistics problems, the designed instrument of data collection itemized some *latent variables* with underlying dimensions of interrelated variables known as (factors) to be reduced using exploratory factor Analysis (principal component analysis). Principal Component Analysis has a purpose to define the underlying structure among variables observed in the analysis. The underlying structure will form a composite that represents the dimension of data structure. From the field survey, the following variables were identified to be responsible for the maritime logistics problems across the five selected seaports. R factor analysis has been adopted in this study in which the dimensions of latent variables were observed. Table 2 shows KMO and Bartlett's Test result. The result tells us about the sampling adequacy of the collected data. The acceptable adequate sample must give a measure that is greater than 0.5 (Field, 2009). The communalities of the analysis using 0.4 as threshold value depict that; variable tank firms (0.249), policy (0.394), clearing (0.384) and Labour Union (0.358) are not significant in the analysis. Although these factors may not have significant communality value, they have significant factor loading. In other words, the factors shall be retained because of factor loadings. Hence, the implication of this is that of all the identified variables, tank firm, truck parking, clearing and Labour Union are ordinarily not supposed to constitute maritime logistics problems. However, looking critically at these factors, policy can be categorized as one of the factors as its value is very close to the threshold value of 0.4 if approximated. This is followed by clearing, labour union and lastly tank firms in Table 3. In the rotated component matrix of Table 3, storage capacity and accessibility for import have the highest loadings 0.958 and 0.957, respectively (Factor 1). Secondly, Charges at the seaport, truck parking and distance required for carriage with 0.706, –0.662 and 0.655,

Table 1 Regression values

Observations	237
R^2	0.5
Adjusted R^2	0.489
Residual standard error	0.000 (df = 231)
F statistic	46.157*** (df = 5; 231)

Note: *p < 0.1; **p < 0.05; ***p < 0.01

Source: output from the analysis (CRAN, 2023)

Table 2 KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of sampling adequacy	0.554	
Bartlett's test of sphericity	approx. Chi-square	701.651
	df	120
	Sig.	0.000

Source: output from the analysis (CRAN, 2023)

Table 3 Rotated component matrix*

	Component				
	1	2	3	4	5
Storage capacity	0.958				
Accessibility for import-export	0.957				
Cost/charges		0.706			
Truck packing		–0.662			
Distance		0.655			
Inadequate ships			0.718		
tons of cargo			0.690		
Labour/union			–0.552		
Commercial transport				–0.652	
port access road				0.602	
Time				0.500	
Handling equipment				0.400	
Policy					
Draught					0.708
Clearing					0.503
Tank firms					0.444

Extraction method: principal component analysis
Rotation method: varimax with Kaiser normalization
* Rotation converged in 7 iterations.

respectively, are the second factor (Factor 2). Inadequacy of ships, the tonnage of goods and labour union constitute the third composite with 0.798, 0.698 and –0.552, respectively (Factor 3). The fourth composite comprises of commercial transport, port access road, time of movement and cargo handling equipment correlated together with values of –0.652, 0.602, 0.500 and 0.400, respectively (Factor 4). Policy as a factor is not shown as it does not meet up with the criterion. The last composite is comprised of draught, clearing and tank firms (Factor 5). Table 4 shows the Eigen values of the factors extracted. Eigen value can be described as the amount of variance accounted for by a particular factor. Applying the latent root criterion, which states that only Eigen values greater than 1.0 should be retained, we have just five variables. However, examining the Scree Test Plot seven factors are presumably fit in to be retained. The reason can be attributed to having Eigen values of 0.989 and 0.898 which are very close to 1.0, respectively. The analysis here has shown the five major composites of the factors that are actually causing maritime logistics problems in Nigeria. The first composite reveals the importance of location as a major factor in seaport logistics. Both capacity and accessibility has to deal with having very large space at a strategic location for seaport logistics in order to achieve optimization. Secondly, cost of operations or charges is seen as another major problem. In this case, the lowest charging seaport seems to be the one to which cargoes are diverted and attempts to increase the cost to reduce demand for seaport has contributed to the part of logistics and entire supply chain problems. Parking of vehicles along the links to the port is under the second composite with a strong Eigen value that depicts its level of wearisomeness. The distance that will be covered from the seaport to hinterland to destination is another challenge. The parking and distance can be termed to be composite two. The tonnage of cargo, labour union and inadequate number of ships are not really serious problems to the maritime logistics. The fourth composite can be looked at as infrastructure challenge. The road, cargo handling equipment time of movement and commercial transportation are serious issues in maritime logistics. Lastly, the draught, clearing and tank firms are least logistics problem for optimization of maritime logistics. The cumbersomeness of moving goods from seaports to hinterland coupled with agglomeration of traffic within the metropolis where seaports are located cannot be solved without intermodal rapid rail transport system and optimal utilization of Inland Container Depots and Container Freight Stations. Capacity of the existing seaports, especially the Western seaports cannot accommodate the ever increasing cargo throughputs that are being generated in the area. With the introduction of Lekki Deep Seaport in Lagos, efficient rail transport system is needed to decongest already congested traffic system. The land use system accommodates all forms like: industrial, commercial, transportation and residential. The right direction has been initiated with ETO only to make it efficient and not to be limited to Truck-call up but also all transactions demanding physical contacts may be automated. The biometric data of all relevant individuals and agencies may be taken for efficient transactions. Not only will this automatically develop transparency system but also a good monitoring and performance based measure. Dedicated routes for trucks along major port-hinterland axes in connection with efficient rail system can also be introduced with affordable charges for transit off-congested

Table 4 Variance explained by eigen values

Component	Total variance explained								
	Initial eigen values			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1 storage capacity	2.34	14.62	14.62	2.34	14.62	14.62	2.09	13.07	13.07
2 accessibility	1.81	11.36	25.99	1.82	11.36	25.99	1.74	10.87	23.95
3 cost/charges	1.56	9.76	35.76	1.56	9.76	35.76	1.72	10.76	34.75
4 truck parking	1.40	8.77	44.53	1.40	8.78	44.54	1.48	9.23	43.95
5 distance	1.28	8.01	52.55	1.28	8.01	52.55	1.38	8.60	52.55
6 inadequate ships	0.98	6.17	58.73						
7 tons of cargoes	0.89	5.61	64.34						
8 labour union	0.87	5.44	69.78						
9 commercial transport	0.86	5.39	75.18						
10 port-access road	0.80	5.01	80.19						
11 time	0.77	4.81	85.01						
12 inad. handling equip	0.69	4.35	89.37						
13 govt. policy	0.62	3.92	93.29						
14 draught/sea level	0.56	3.50	96.79						
15 clearing process	0.46	2.88	99.67						
16 tank firms	0.05	0.32	100						

Extraction method: principal component analysis
Source: output from the analysis Output from IBM SPSS Statistics (IBM Corp. Released, 2021)

areas. The entry and exit routes must be planned. When the port or traffic is congested, it becomes the game of highest bidder becomes the winner. Lobbying to influence the system will always cause increase in charges of freight movement until there is efficient and transparent automated logistics system. Queues bring about chaos and increase in service rate and channels of exits can ease its challenges. It is therefore important for relevant agencies to increase their processing speed in cargo clearance, cargo handling and freight movement. Parking reduces the space on access road to the port; there are no other places to park most especially when a number of vehicles have been called for cargo reception. The condition of the vehicle (truck) and the road is very important. Parking of different vehicles used in conveying different cargoes are one of the serious challenges in port-hinterland logistics. A critical issue is when tanker trucks are parked alongside with container trucks within the port area accessing same or tangential locations for their carriage. The required number of ships to be involved in shipping trade in Nigeria is limited with incessant disagreements among labour union in shipping logistics.

6 Conclusion and recommendations

Increase in seaport activities and global supply chain as witnessed at the major Nigerian seaports cannot be tamed for rapid development and expansion. However, as the port expands or develops, strategies must be put in place that, use diffusion strategy to reduce the congestion occasioned by activities tangentially related to port and others. There are many factors responsible for inefficient port-hinterland and logistics in Nigeria. This paper has considered the constraints against the use of ICDs and CFSs and also the port-hinterland logistics. In spite of all efforts

and strategies to guarantee efficient movement of goods, the problems persist. As analysed, 50% of constraints against the use of ICDs and CFSs came from rail transport. Non functionality of efficient rail system linking the ports to the hinterland will continue to increase congestion and by implication create problems of accessibility, exorbitant charges for transport and its multiplier effects of cost of imported goods and services. Efficient train operations and making ICDs both port of origin and destinations like seaport will diffuse the logistics activities around the seaports. For rapid movement of different cargo, lanes can be dedicated for passengers, liquid and containerized goods with connection to the ICDs. It is of great importance for Nigeria to examine what is wrong with the rail transport system especially connecting these ports and hinterland. The percentage share of it in decongesting ports is very high and it means if the country can solve the problem with rail system connecting the seaports, half of the problems is solved. From the Principal Components Analysis (PCA) the first identified causative factor of hinterland-seaport logistics problem was capacity. Most of the Nigerian seaports do not have adequate capacity to accommodate ever increasing cargo the resultant effect of which is inevitable congestion. This has partly been solved with the establishment of Lekki deep seaport in Lagos. However, it may create further problems because establishment of seaport without means of rapidly evacuate cargoes from the port to the hinterland or destinations will compound the problem. Another critical issue is parking and charges to be paid at the ports. The introduction of innovative ways of parking through Electronic Truck Order (ETO) system is one of the best so far. Unfortunately, corrupt practices were observed to characterize and mar the process. The charges that workers and agencies working at Nigerian ports create after the official government charges should be streamlined. There is need for government to release Cabotage Vessel Financing Funds (CVFF) for indigenous ship owners with adequate and monitoring policy so as to have enough vessels plying the continents from Nigeria. Since ports areas are commercial and industrial cities, the movement of commercial vehicles and interactions with vehicular and passengers movement must be separated to avoid accidents, congestion and to create efficient movement of goods and services. All cargo handling equipment, labour among other critical factors with stringent enforcement or policy should be monitored.

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