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# Assessment of Seaport Competitiveness in Nigeria: An Analytical Hierarchical Process Approach

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## Abstract

This study combined primary and secondary data to analyse the competition existing among Nigerian seaports. A survey conducted among port users to determine the relative weights of port competitive variables. The data on the variables were obtained from abstracts of port statistics. The competitiveness of the ports was assessed by Analytical Hierarchical Process (AHP) using the sets of data. The first leg of the analysis determined the competitiveness of the ports with respect to each of the port competitive variables (which include port throughput, vessel traffic, port draught, Quay length, cargo dwell time, pre-berth waiting time, vessel turnaround time, truck turnaround time, crane productivity, cargo handling charge and shipping connectivity index). The second leg of the analysis assessed the overall competitiveness of the ports using the results obtained across the variables and the weights gotten from the survey. The result of the overall competitiveness of the ports shows that Onne is the most competitive port, pulling 21.087% of the combined attributes considered. It is followed by Tin-Can (19.660%), Apapa (17.799%), Delta (14.473%), Rivers (12.421%) and Calabar (10.926%). Armed with the competitiveness of the ports across the variables and their overall competitiveness, vital policy implications were drawn.

***Keywords*****:** *port throughput, vessel turn-round time, vessel traffic, competitiveness, analytical hierarchical process (AHP).*

## 1.0 Introduction

Globalization, standardization and deregulation are intensifying port competition. Seamless movement of shipments between ocean and surface transport with independent rates has affected many ports (Malchow & Kanafani, 2004). The emergence of hub ports is another trend that has relegated many ports into becoming 'spokes' or feeder ports to the few hub ones (Chang, Lee, & Tongzon, 2008). What this portends is that any port that wishes to be relevant in the business of international trade must be competitive in its service provisions. It is in a bid to make Nigerian ports competitive that this study will explore the factors that inform the port selection decisions of major port users.

Competition is not a new phenomenon in a non-monopolistic market. Firms are allowed to compete among themselves. Competition tends to keep the firms on their toes to ensure that they satisfy their customers, increase their market shares or at least retain their clients. This type of competition is fair, healthy and constructive, because it brings out the best in the producers or service providers, as they struggle to satisfy their customers. In the same vein, ports compete among themselves to satisfy their customers, increase their market shares or retain their clients.

Ports compete mainly through their investment programs and marketing efforts. The investment may take the form of improvement of intermodal facilities to minimize the dwell time of shipments, expanding the wharf and storage locations to allow carriers to concentrate operations, improving cargo handling facilities to increase port efficiency or dredging of their waters to allow deployment of larger vessels by carriers.

Marketing efforts may be by building port's image, integration with major logistics chains, fair pricing, service incentives or motivations (Malchow & Kanafani, 2004).

Though ports are gateways to nations' economies, only few sets of people are regarded as the customers. They comprise the carriers, the shippers (consignee and consignor) and the freight forwarders. The decision to route cargo through a port lies ultimately with the buyer (consignee). He places the order, defines the terms of sale, makes payment for the goods and takes delivery of the shipments. The seller or consignor on the other hand may be a marketer, middleman or factory owner who fulfils the content of the order. The carriers decide on vessels deployment to routes and ports as well as assignment of shipments to vessels, while the freight forwarders facilitate the business (Tongzon, 2009).

Hence port selection decision lies with shipping lines, the shippers and the freight forwarder. This research attempts to determine the competitiveness of the ports in the Nigeria and also assess the factors that will put Nigerian ports on the best footing to attract the port choice decisions of these major port users.

### 1.1 Problem Statement

The major problem that arises is an unquantifiable loss of revenue and employment to the neighbouring ports (Chikere, Ibe, Stephen, Nze, & Ukpere, 2014). This is because there is no means of accounting for the losses. However, any shipment meant for Nigerian market that arrives in a neighbouring port finds its way into Nigeria through three major ways. It may be by cartelization, independent smugglers or due process. The first two cases deprive the government of the accruable revenue and the third is a huge loss to the economy and Nigerians that go there to buy, because they pay customs duty to two nations. Wcounorthy also to mention is the good number of jobs lost to the neighbouring tries. All these are the penalties arising from the unfriendly nature of Nigerian ports which this study will attempt to address.

There are speculations that a logistic hub will soon be introduced in West Africa. Nigeria has an advantage in attracting such a huge investment, going by her population and the volume of international trade she controls (PrincewaterCoopers, 2013). However, there are lots of impediments making the realization of this dream look so dim. Urgent steps need to be taken to ensure that Nigerian ports are not relegated to feeder ports, irrespective of her population and market. The removal of these impediments to gain the hub status is a major focus of this research.

The documentation, clearance and delivery of goods within Nigerian ports take between 10 to 30 days, other things being equal. This range is much when compared with 3 days obtainable in some neighbouring ports. This delay is the major cause of cargo congestion experienced in Nigerian ports. Apart from the time, the cost of clearance and some other applicable charges like demurrage are also on the high side in Nigerian ports (Omoke, 2008).

This study focuses on exploring the factors of ports' competitiveness on one hand and determining the actual competitiveness of the ports in the region on the other hand. Armed with the competitive positions of the ports as well as the factors of ports' competitiveness will not only help Nigerian ports to adjust and compete favourably with the neighbouring ports, but also with the Western ports, because shipping is an international business and the world is a 'global village' (Omoke, 2008).

### 1.2 Justification of the Study

There is a need to woo the new port users to use Nigerian seaports and to retain the old clients that are already using Nigerian ports. The Nigerian government and the ports authority need to know the degree of competitiveness of Nigerian ports in relation to the neighbouring ports, and also the primary factors that can help them secure the full patronage of the port users. Armed with the ports competitiveness and keeping a tab on these factors can help the authorities to redirect the orientation of Nigerian shippers that are already patronizing the neighbouring ports.

The huge revenue lost annually by Nigerian ports to the neighbouring ports will be fully addressed. The employment that will be generated is enormous. All these will go a long way to boost the economy.

Oceanic and inland distances, location, port costs and infrastructure were the significant factors for port selection identified by Malchow & Kafanni (2004), Ha (2003), Tongzon & Sawant (2007) and Song & Yeo (2004) respectively. However, there is a need to determine the effects of some efficiency factors on port's competitiveness, which are important to most port users. This study will close this gap by determining the effects of some efficiency factors like vessel turnaround time, pre-berthing waiting time, cargo dwell time and crane productivity on port competitiveness.

Studies on port selection were conducted based on a single user's perspective; with some researchers focusing only on carriers', freight forwarders' or shippers' perspective (Acosta, Coronado & Cerban, 2010; Saeed, 2009; Lirn, Thanopoulou, Beynon & Beresford, 2004; De Langen, 2007). There is a need to conduct a study that will be in the perspective of all the port users (involving the shippers, freight forwarders and carriers). A study involving all the port users will provide stronger basis for decision makers. Analysis of port competitiveness in the perspective of all the port users is another gap this study will attempt to close.

Nigerian ports should not only struggle to survive amidst local and global competition, they should strive to be among the best in world. With the numerous advantages they have over the neighbouring ports, there is every chance that one of the ports will emerge a hub port in the near future. This study will act as a facilitator in making the ports more appealing to the local and global users.

### 1.3 Objectives of the Study

The specific objectives of the research are:

i. To assess the levels of importance of the competitive factors involved in seaport selection.
ii. To evaluate the competitiveness of each of the seaports across the competitive factors involved in port selection.
iii. To determine the overall competitiveness of each of the seaports in Nigeria.
iv. To draw policy implications and recommendations based on the outcome of the study.

## 2.0 Literature Review

### 2.1 Definition of Ports

Ports are dissimilar in their roles, assets, functions and institutional organizations (Bichou & Gray 2005). So many definitions exist for the port. They can range from a small quay for berthing a ship to a large-scale centre with numerous terminals and a cluster of industries and services. Traditionally, seaports are regarded as gateways for transferring cargo and passengers between vessel and shore (Meersman et al, 2010). However, this definition is too restrictive, for the sphere of influence of a port extends well beyond its own perimeter, both towards the hinterland and the open sea. Notteboom (2001) defined a port as a

logistic and industrial centre of an outspokenly maritime nature that plays an active role in the global transport system and that is characterised by a spatial and functional clustering of activities that are directly and indirectly involved in 'seamless' transportation and information processes in production chains. This last definition would be adopted for the purpose of this research.

A typical port consists of more than a port authority and a terminal operating company. Many different players and decision-makers are active within ports and indeed within the maritime sector as a whole (Meersman et al, 2009). The other actors may be roughly divided into two groups: the port users and the service providers. Among the port users are, first and foremost, the shipping companies. Also belonging to this group are the shippers and industrial enterprises that are established within the port perimeter and have land in concession. The service providers are a heterogeneous group: pilots, towage services, agents, forwarders, ship repairers, suppliers of foodstuffs and spare parts, waste reception facilities, bunker services, and stevedores, who are increasingly evolving into terminal operating companies (TOCs), constituting a special case. TOCs provide services (transhipment, storage, stripping and stuffing) to shipping companies and shippers, for which they are effectively remunerated. At the same time, they pay the port authorities for terminal concessions.

### 2.2 Port Competition

There is no consensus existing on what is precisely meant by “port competition”. However, a substantial body of literature exists, which attempts to define the concept and identify the actors involved in seaport competition (Heaver, 1995; Goss, 1999d; Hayuth, 1993; Verhoeff, 1997)

Traditionally, port competition has been considered as “competition among or within ports” to secure the highest patronage of port users. Verhoeff (1977) identified four levels of port competition fully distinguished on geographical basis:

1. Intra-port competition- competition among companies found in the same port,
2. Inter-port competition- competition among ports,
3. Competition among port clusters (this is among a group of ports with joint geographical characteristics) and
4. Competition among port ranges (with a range defined as a number of ports sharing the same coastline and having a more or less common hinterland.

Verhoeff (1977) further suggested that each of the four levels of competition may affect the other levels. Hence, the levels are related.

It is essential for port to have a power of competition which places it above other ports. The competitive power of ports presents ship owners or shippers with the standard of selecting ports. Port operators can utilize that power as a guide necessary for counter measures, by grasping the advantages and disadvantages of ports, and the prime factors of opportunities and threats of ports with environments changing (Yang, 1999).

### 2.3 Levels of Port Competition

The first level is “inter-port competition on port authority level”. This involves the different levels of government (local, regional and national) trying to improve the competitive position of a port by providing the most optimal working conditions and by responding to the port’s needs (like additional infrastructure

and expansion). With the realities of scarce resources, infrastructure provision has been increasingly difficult. Also, the allocation of public funds to ports is mostly preceded by detailed and rigorous socio-economic studies on profitability and feasibility of the proposed projects (Haezendonck, 2001)

Apart from infrastructural provisions, governments have attempted to improve competitiveness by concentrating on promotion activities and provision of support services like security and enabling environment. However, the port authority usually plays a key role in determining both the content of such government intervention and the method and channel through which government resources are allocated for specific purpose in line with the port's interest (Haezendonck, 2001)

The second level of port competition is the "inter-port competition based on commodity level". According to Haezendonck (2001), port competition occurs within special traffic categories. For instance, two or more ports (like Apapa, Tema and Cotonou) can be in competition in order to gain an increased market share or to improve their position in specific trade such as container traffic.

The third level of port competition is "inter-port competition on port range level". A range may be defined by common coastline or hinterland. For instance, most of the ports considered in this study are situated in the same coastline (West African Coast), with some having common hinterlands. Hence, the definition of a range provides the basis upon which the competitive positions of the ports can be determined.

**2.4 Port Competitive Position**

The competitive position of a port is determined by its competitive offering to the host of shippers and shipping lines for specific trade routes, geographical regions and other ports to which the port is connected. However, at the broader dimension, the competitiveness of a port is determined by the range of competitive advantages that are acquired or created by the port over time (Haezendonck & Notteboom, 2002). Consolidating the list of factors drawn from various perspectives showed that a port is likely to be more competitive if the port:

- enjoys proximity to key centres of production and consumption, and major trade lanes;
- possesses excellent maritime and hinterland access and offers superior connectivity to markets;
- is able to reduce port costs for users through higher productivity;
- is able to persuade and entrench carriers and shippers in relation to their cargo routings by adding value to the business pursuits of these entities;
- is able to expand capacity in time to meet demand and has sufficient space to cater to future development and capacity extensions;
- enables users to compete effectively with other transport modes;
- is able to cope with challenges posed by the new logistics business environment;
- is able to capitalize on the complementary and reinforcing effects of the port cluster;
- has greater involvement from the private sector at the level of terminal operations;
- is perceived to be a key driver of the local economy;
- and enjoys a long tradition of support from key stakeholders in the port area and the wider community (Notteboom & Yap, 2012)

The decision by a shipping line to switch from one port-of-call to another can lead to significant economic and commercial effects, for both ports. Ports which show less flexibility in accommodating the requirements of shipping lines may be circumvented, while ports that are able to complement and add

value to the objectives of liner shipping companies will become preferred channels of cargo traffic. Consequently, ports that are competitive will become focal points for key arteries of trade. This means that ports may have to serve as collection and distribution points for hinterlands that extend far beyond their traditional boundaries, and deal with issues and challenges that are presented by the whole logistics chain (Notteboom & Yap, 2012)

### 2.5 Theory of Competition

The classical perspective on competition was that certain agreements and business practice could be an unreasonable restraint on the individual liberty of trades (to carry on their livelihoods). Restraints were judged as permissible or not by courts as new cases appeared and in the light of changing business circumstances. Hence the courts found specific categories of agreement, specific clauses, to fall foul of their doctrine on economic fairness, and they did not contrive an overarching conception of market power (Smith, 1776)

According to Smith (1776), "A monopoly granted either to an individual or to a trading company has the same effect as a secret in trade or manufactures". The monopolists, by keeping the market constantly under-stocked, by never fully supplying the effectual demand, sell their commodities much above the natural price, and raise their emoluments, whether they consist in wages or profit, greatly above their natural rate. He pointed out the cartel problem, but did not advocate legal measures to combat them, and also rejected the very existence of, not just dominant and abusive corporations.

By the latter half of the nineteenth century, a laid down treaty on liberty emerged which says that, "Again, trade is a social act. Whoever undertakes to sell any description of goods to the public, does what affects the interest of other persons, and of society in general; and thus his conduct, in principle, comes within the jurisdiction of society... both the cheapness and the good quality of commodities are most effectually provided for by leaving the producers and sellers perfectly free, under the sole check of equal freedom to the buyers for supplying themselves elsewhere". This is the so-called doctrine of Free Trade, which rests on grounds different from, though equally solid with the principle of individual liberty. Restrictions on trade, or on production for purposes of trade, are indeed restraints; and all restraint is an evil (Mill, 1859)

After Mill, there was a shift in economic theory, which emphasised a more precise theoretical model of competition. A simple neo-classical model of free markets holds that production and distribution of goods and services in competitive free markets maximizes social welfare. This model assumes that new firms can freely enter markets and compete with existing firms, or to use legal language, there are no barriers to entry. By this term economists mean something very specific, that competitive free markets deliver allocative, productive and dynamic efficiency. Allocative efficiency is also known as Pareto efficiency, meaning that resources in an economy over the long run will go precisely to those who are willing and able to pay for them. Because rational producers will keep producing and selling, and buyers will keep buying up to the last marginal unit of possible output - or alternatively rational producers will reduce their output to the margin at which buyers will buy the same amount as produced - there is no waste, the greatest number wants of the greatest number of people become satisfied and utility is perfected because resources can no longer be reallocated to make anyone better off without making someone else worse off; society has achieved allocative efficiency. Productive efficiency simply means that society is making as much as it can. Free markets are meant to reward those who work hard and therefore those who will put society's resources towards the frontier of its possible production. Dynamic efficiency refers to the idea that

business which constantly competes must research, create and innovate to keep its share of consumers. (Galbraith, 1967)

Contrasting with the allocatively, productively and dynamically efficient market model are monopolies, oligopolies, and cartels. When only one or a few firms exist in the market, and there is no credible threat of the entry of competing firms, prices rise above the competitive level, to either a monopolistic or oligopolistic equilibrium price. Production is also decreased, further decreasing social welfare by creating a deadweight loss. Sources of this market power are said to include the existence of externalities, barriers to entry of the market, and the free rider problem. Markets may fail to be efficient for a variety of reasons, so the exception of competition law's intervention to the rule of *laissez faire* is justified. Orthodox economists fully acknowledge that perfect competition is seldom observed in the real world, and so aim for what is called "workable competition". This follows the theory that if one cannot achieve the ideal, then go for the second best option by using the law to tame market operation where it can (Whish, 2003).

A group of economists and lawyers, who are largely associated with the University of Chicago, advocated an approach to competition law guided by the proposition that some actions that were originally considered to be anticompetitive could actually promote competition. The US Supreme Court has used the Chicago School approach in several recent cases (Posner, 2001; 2007)

Bork argued that both the original intention of antitrust laws and economic efficiency was pursuit only of consumer welfare, the protection of competition rather than competitors. Furthermore, only a few acts should be prohibited, namely cartels that fix prices and divide markets, mergers that create monopolies, and dominant firms pricing predatorily, while allowing such practices as vertical agreements and price discrimination on the grounds that it did not harm consumers. Running through the different critiques of US antitrust policy is the common theme that government interference in the operation of free markets does more harm than good (Bork, 1978)

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`Anti-cartel enforcement is a key focus of competition law enforcement policy. In the United States the Antitrust Criminal Penalty Enhancement and Reform Act 2004 raised the maximum imprisonment term for price fixing from three to ten years, and the maximum fine from $10 million to $100 million (Pate, 2004)

Some economic libertarians have criticised competition law in its entirety, challenging the legitimacy of action against price fixing and cartels (DeBow, 2007)

Lirn et al (2004) analyzed liners transhipment port selection using analytic hierarchical process (AHP). They found that container liners and port service providers have a similar perception about the most important service characteristics for port selection, but the weights among the sub-criteria differ in the two survey groups. The five most important service attributes are handling cost, proximity to the main navigation routes, proximity to import/export areas, infrastructure condition and feeder network.

De Langen (2007) studied Australian shippers and freight forwarders port choice factors and found that they share similar port selection criteria; however they differ in terms of their response to price elasticity of demand.

Chang et al (2008) investigated the factor affecting shipping companies' port choice using exploratory factor and confirmatory factor analyses. They identified five port choice categories as
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advancement/convenience of port, physical/operational ability of port, operational condition of shipping lines, marketability and port charges. Their comparison between the main trunk and feeder service providers indicated that the former face more intense competition than the later. They also found that the main haul shipping lines are more sensitive to port cost factors.

Sayara and Rezaee (2014) weighed the most dominant decision-making criteria by Technique for Order Preference to Similarity by Ideal Solution (TOPSIS) as a method of selecting an optimized container seaport in the Persian Gulf. They found that the working time, stevedoring rate, safety, port entrance, sufficient draft, capacity of port facilities, operating cost, number of berths, ship chandelling, and international policies are critical factors for selecting container seaport in the Persian Gulf

Recent studies show that there are a number of common determinants of port competitiveness, though the order may change depending on the port and the type of traffic studied. Tongzon (2002, 2007), Lirn et al (2003, 2004), Song and Yeo (2004) stress the importance of port infrastructure, geographic location and port costs as the main factor influencing ports competitiveness.

Notteboom (2008) stresses that another key determinant in addition to the traditional factors is excellence in the logistic chain in which the port is involved. This translates into providing a better service at lower costs for the clients.

### 2.6 Study Area: A Brief Review of Nigerian Seaports

#### Lagos Port Complex

The Lagos Port Complex is the largest in West and Central African sub-regions. Its history dates back to 1914, when the defunct Customs Wharf came into existence. The complex covers about 200 hectares of land. Currently, the port houses four private terminal operators – AP Moller Terminal, Apapa Bulk Terminal, ENL Consortium and Greenview Development Nigeria Limited, a subsidiary of Dango Port Operations.

The port's infrastructure include two berths for dry bulk cargo, 19 berths for general cargo, six berths for container handling and one berth for Roll-on-Roll-Off operations. Cargo discharged at the ports included bulk cement, bulk fertilizer, wheat, fish, rice vegetable oil, petroleum products and various containerised cargo. There are two inner harbours for loading and discharging of refined petroleum products. Besides, there are four jetties for coastal fishing vessels and trawlers.

The premier port has 13 sheds, providing a space of 57,042 square metres and 14 stacking areas for general cargo and empty containers before it was concessioned in April, 1996. Its quay, excluding the third wharf, covers a land area of about 100 hectares with a length of 2,459 metres, capable of handling up to 20 loading and discharging vessels at a time. The quay is served by rail, road and water transport. Its network is directly linked with the mainland system of the Nigerian Railway Corporation. It has facilities to discharge bulk wheat and cement, including the loading of wheat offal compressed into pellets at the berths. The bulk wheat grains are discharged by means of a static pneumatic elevator directly from the vessel at Berth 1 to the silos outside the port area. The silos storage capacity is 76,600 tonnes.

The third wharf is a southern extension to the old Apapa quay along the Badagry Creek. It has a total quay length of 1,600 metres with a maximum 10.5 metres draught of water alongside. The facilities comprise 1,005 metres of containers berths capable of accommodating four to six container ships at a time, 525-metre long multipurpose berths capable of berthing three conventional cargo, RoRo vessels at a time, four

finger jetties for service crafts and tugs. Its total storage is 6.400. The container depot at the third wharf extension is 200,000 square metres of storage space while the Ijora Lilypond Road Container depot can accommodate 6,800 TEUS.

At the port complex is a large well-equipped dockyard maintained by the Nigerian Ports Authority. Although it was built primarily for the maintenance of NPA's fleet, it provides facilities to commercial interests. Slipways are also available for the use of small crafts. Between the dockyard and Apapa quays is a fish wharf. It is an 11.5-metre quay. It houses a privately-owned transit cold store with a capacity of 1.500 tonnes for frozen fish, meat and shrimp.

The port has a 50-metre jetty which can be used by vessels of up to 152 metres in length and draught of 7.92 metres. It is used for vegetable oil but could be used to discharge petroleum product. There are also petroleum wharves for oil tankers. They are designed for discharging or loading of refined petroleum products. The wharves have direct pipeline connecting the tank installations of various oil companies.

The port lacks adequate security judging by the number of crimes recorded daily. Although efforts have been made by the Nigerian Ports Authority and the Port Authority Police Command to combat rising crime, inadequate funding has marred such efforts. Cases of container diversion, broaching, pilfering and conspiracy are common in the port due to its porosity, leading to large influx of layabouts. However, there is security for port users as access to the terminals has been curbed to some extent by the concessionaires.

With the concession of the port to four terminal operators, the Lagos Port Complex is fast becoming the hub of shipping activities in the West and Central African sub-regions. There is a lot of investment on plants and equipment by the operators while the NPA is dredging the channel to pave the way for Panama's vessels. With this lead time for cargo from procurement at the port of origin to shelve in Nigerian port, importers would save significant amount of money. Proper stacking arrangements and organisation of containers for transhipment would no longer be a problem.

**Tin-Can Island Port Complex (TCIP)**

TCIPC of today is an amalgam of what used to be Roll-on-Roll-off (RORO) and Tin Can Island ports. This merger came with the concession of the terminals in May, 2006. The port was constructed and commissioned on the 14th October, 1977. Having been concessioned to private sector operators, TCIPC now hosts five concessionaires. They are:

- Josepdam Port Services Ltd which occupies an area of 5.6 hectares on terminal A with a quay length of 484 metres. Their area of operation covers berth number 1, 1A &2 at Tin Can Island port, with specialization in bulk and general cargo delivery.
- Tin Can Container Terminal Ltd is located on terminal B, with operating berth number 3,4,4A and 5 over 22.23 hectares and 764.6 metres. It is one of the leading container handling operators in Nigeria.
- Port and Cargo Handling Services Ltd, situated on terminal C, operates from berths 6, 7, 7A and 8 stretched over 16.65metre quay length and 5.6 hectares. It handles bulk and containerized cargoes.
- Five stars Logistics Ltd located at terminal D, operates from berths 9 and 10, over 437.03 metres and an area of 18.67 hectares. It handles RORO, containerized and general cargos.

- Port and Terminal Multi-Services Nigeria Ltd (PTML) has terminal 11 and 12 as its base. It was built on Build Operate and Transfer (BOT) arrangement. It handles RORO, containerized and general cargoes. It is built on a 5oo metre quay length facility covering an area of 12.2 hectares.
- Kirikiri Lighter Terminals 1 & 2 (KLT) is operated by various maritime operators. It covers an area of 1052.5 metres quay length and 503 hectares while KLT 2 covers an area of 762.62 metres and 37.62 hectares. The terminal handles containerized, bulk and liquid bulk cargoes.

**Delta Port**

Delta Port is located in the petroleum and natural gas producing Niger River Delta region of Nigeria. Delta Port in Delta State includes the ports of Warri, Burutu, Sapele and petroleum terminals at Escravos, Forcados and Pennington.

Delta Port is unique and has enormous capacity yearning for development. Because of the immense potentials that abound in the port, thus it is adjudged to be the port of the future, it provides advantages that set it apart, and place it on a class of its own. Those selling points are: shorter distance for haulages of cargoes for catchment states of Anambra, IMO, Enugu, Delta, Edo, Kogi, Ondo, Benue , etc when compared with other operational ports. It has capacity to generate its own cargo as the port has been surviving on captive cargoes over the years. There is the emergence of new growth drivers in the export of gas by the EGTL facilities that is about to commence production with a capacity next to non in the country.

**Onne Port**

Onee is located in Rivers State on Ogu Creek near the Bonny River, 19 km from Port Harcourt; the port area is located in three Local Government Areas of Rivers State, Eleme LGA, Ogu-Bolo LGA and Bonny LGA. The port consists of two major facilities, the Federal Ocean Terminal and the Federal Lighter Terminal. Onne Port has been designated as an Oil and Gas Free Zone by the government of Nigeria; currently over 100 companies have licenses to work at Onne Port; as an economic free zone it serves as a hub port for oil and gas operations throughout West Africa and Central Africa.

**Rivers Port**

The Rivers Port Complex in coastal Rivers State comprises Port of Port Harcourt, Okrika Refined Petroleum Oil Jetty, Haastrup/Eagle Bulk Cement Jetty, Kidney Island Jetty, Ibeto Jetty, Macobar Jetty and Bitumen Jetty. Management of port operations at Port Harcourt itself has been commissioned out to two port operators, Ports and Terminal Operators and BUA Ports and Terminal, it is not operated by the NPA. Like Delta State, Rivers State is a principal petroleum-producing region of Nigeria.

**Calabar Port**

Historically, Calabar port served as an important focus of trade with the outside world for the Eastern States and a natural harbour for the Northern States of Nigeria right from the pre-colonial and colonial times.

The Old Port was privately administered and operated by various shipping companies amongst whom were M/S Palm line Agencies Limited and Elder Dempster Agencies until December 1969 when the Federal Government took over the inadequate Calabar Port facilities from the erstwhile operators and vested it on the Nigerian Ports Authority.

The development, modernization and expansion of the Calabar Port was embarked upon under the 3rd

National Development plan 1975 –1980 in order to make the Port facilities cope with the ever increasing demand of our economy. The new Port Complex was commissioned on 9th June, 1979 and consists of the following major operational areas:-

- The Port has a total land area of 38 hectares.
- The Port has a total of Four Quays each measuring about 215m long and 40m wide.
- The Four Quays have been decimated into six operational berths.
- The Port also have 2 warehouses measuring 150m X 40m and 175m X 40m.
- The Port operational Area have been divided into two concessioned terminals.
- Terminal A consisting of two berths was concessioned to Messrs Intels Nigeria Ltd.
- Terminal B consisting of four berths was concessioned to Messrs ECM Terminal Ltd

The Port is Located along latitude 4055'N and Long 8015'E. The New port lies about 55nautical miles from the fairway buoy up to Calabar River. The Port occupies an area of approximately (38) hectares of land. buoyed channel (150) metres wide

## 3.0 Methodology

### 3.1 Research Design

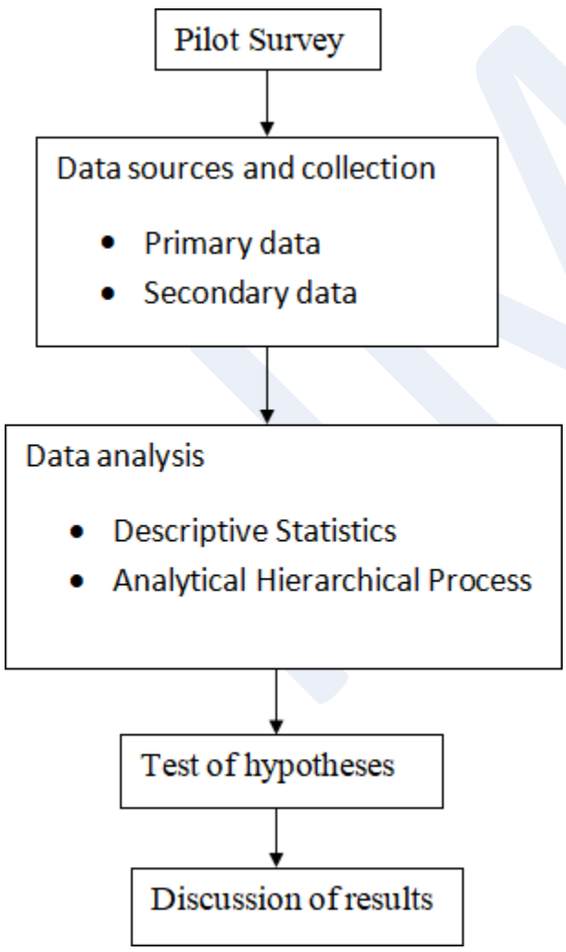


Figure 3.1: Schematic presentation of research design

Source: Author's design

### 3.2 Data Collection

The research commenced with a pilot survey aimed at identifying the competitive criteria, which are the key factors that form the basis of port competitiveness Nigeria. In the pilot survey, the names, addresses (physical locations and emails) and phone numbers of the respondents were compiled. The factors identified in the survey were combined with those obtained from literature to form the competitive criteria.

Data were obtained from primary and secondary sources. Primary data come from a sample of 450 port users comprising shipping line personnel, shippers, freight forwarders and research professionals in Nigeria. They were required to rank the port choice factors from 1 (least important) to 10 (most important) to obtain their relative weights or importance. Questionnaire was the survey instrument, which was administered via the email and physical addresses obtained from the pilot survey. Delphi technique was deployed to select the respondent.

The secondary data was obtained from the abstract of ports statistics of Nigerian seaports for analysing the pattern of competition experienced by the ports in Nigeria. Some of the data were also obtained from the ports' websites, World Bank, and United Nations Conference on Trade and Development (UNCTAD).

### 3.3 Sample Size Determination

According to Israel (1992),

Minimum Sample Size (n) = $(Z\text{-score})^2 * StdDev*(1-StdDev) / (\text{margin of error})^2$

Choosing 95% confidence level (with Z-score = 1.96), standard deviation (StdDev = .5), and a margin of error of +/- 5% and putting the values into the equation gives

$n = ((1.96)^2 \text{ x } .5(.5))/(.05)^2$

$= (3.8416x.25)/.0025$

$= .9604/.0025$

$= 384.16$

= 385 respondents are needed

This implies that at least 385 respondents are needed

### 3.4 Methods of Data Analysis

Two distinct approaches were deployed in this study, namely descriptive statistics and analytical hierarchical process.

### Descriptive Statistics

Descriptive statistics entails describing the main features of a collection of information quantitatively. It aims at summarizing a sample, rather than use the data to learn about the population that the sample of data is thought to represent. These summaries formed the basis of the initial description of the data as part of a more extensive statistical analysis.

A sample of 450 port operators comprising shipping lines personnel, shippers freight forwarders and research professionals in West Africa were asked to rank the port choice factors from 10 (most important) to 1 (least important) to obtain their relative importance. The survey was conducted through questionnaires, email, telephone and face-to-face interviews. The result was aggregated to obtain the overall ranking. The lowest rank, highest rank, mean rank and the standard deviation for each of the port

choice factors were determined and discussed. The mean weights of the variables were calculated to generate the comparison matrix of AHP criteria.

**Analytic Hierarchy Process (AHP)**

The analytic hierarchy process is a structured technique for organizing and analyzing complex decisions based on mathematics and psychology. It was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then.

*Structure of the Decision Problem Considered*

The structure of the typical decision problem considered in this research consists of a number of M alternatives and N decision criteria. Each alternative was evaluated in terms of the decision criteria and the relative importance (weight) of each criterion was also determined.

Let $a_{ij}$ (I = 1,2,3,…M, and j = 1,2,3,…N) denote the performance value of the *i*th alternative ($A_i$) in terms of the *j*th criterion ($C_j$). Also let the weight of the criterion $C_j$ be $W_j$. The typical multi-criteria decision-making (MCDM) problem can be represented by the following **decision matrix:**

| Criterion | $C_1$ | $C_2$ | $C_3$ | … | $C_N$ |
|---|---|---|---|---|---|
| Alt. | $W_1$ | $W_2$ | $W_3$ | … | $W_N$ |
| $A_1$ | $a_{11}$ | $a_{12}$ | $a_{13}$ | … | $a_{1N}$ |
| $A_2$ | $a_{21}$ | $a_{22}$ | $a_{23}$ | … | $a_{2N}$ |
| $A_3$ | $a_{31}$ | $a_{32}$ | $a_{33}$ | … | $a_{3N}$ |
| . | . | . | . | . | . |
| . | . | . | . | . | . |
| . | . | . | . | . | . |
| $A_M$ | $a_{M1}$ | $a_{M2}$ | $a_{M3}$ | … | $a_{MN}$ |

Given the above decision matrix, the decision problem considered in the study was how to determine the best alternative. The problem could also focus on determining the relative significance of the M alternatives when examined in terms of the N decision criteria combined.

After all the alternatives were compared with each other in terms of each of the decision criteria and the individual priority vectors derived, the synthesis step was taken. The weights of importance of the criteria were also determined by comparisons. Therefore, if a problem has M alternatives and N criteria, then the decision maker is required to construct N judgment matrices (one for each criterion) of order MxM and one judgment matrix of order NxN (for the N criteria). Finally, given a decision matrix the final priorities, denoted by $A^i_{APH}$, of the alternatives in terms of all the criteria combined are determined according to the following formula (Triantaphyllous and Mann, 1995).

$A^{i}_{APH} = \sum_{j=1}^{N} a_{ij} w_j$, for i = 1, 2, 3, … M ……(1)

**Competitive Criteria**

The competitiveness of a port can be determined by assessing the competitive factors or variables. The competitive variables like port throughput, vessel traffic, port draught, quay length, cargo dwell time, pre-berthing waiting time, vessel turnaround time, truck turnaround time, crane productivity, cargo handling charge and shipping connectivity index are necessary to gauge the actual competitiveness of the ports. Assessment of port competition based on each factor gives rise to the performance of the port with respect to that specific variable. The aggregate of the competitive positions of a port in each of the competitive criteria gives its overall competitiveness.

**AHP Design of Port Competition in Nigeria**

The first stage in the analysis started with the design of the AHP model. The model here has three major components; the goal, the criteria and the alternatives. A port is competitive when it has sufficient appeal to the customers and makes them to patronize the port. The degree of this patronage is determined by the cumulative weight of the competitive input and output factors found in the port. The competitive factors are port throughput, vessel traffic, port draught, quay length, cargo dwell time, pre-berthing waiting time, vessel turnaround time, truck turnaround time, crane productivity, cargo handling charge, and shipping connectivity index. It was on the basis of the above variables that the ports of Apapa, Tin-Can, Delta, Onne, Rivers, Calabar were evaluated to determine their relative competitiveness.

Considering the structure of the design, Matlab software, Microsoft Excel and Priority Estimation Tool (PriEsT–allinone-v2.1) were deployed for the analysis.

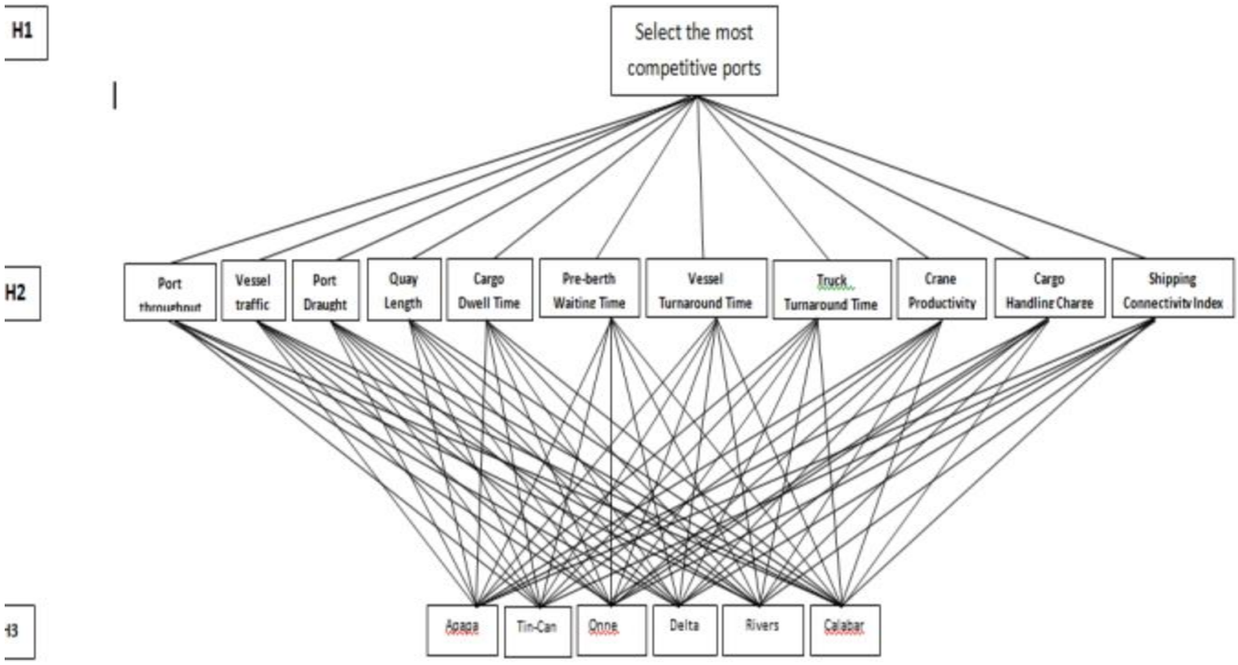


Figure 3.2: AHP model of port competition in Nigeria

Source: Author's design



**Comparison of AHP Criteria**

This has to do with determining the relative weight or importance of the criteria for port competitiveness. It was the major result of a survey that was conducted among shippers, freight forwarders and carriers to determine the relative importance of port throughput, vessel traffic, port draught, quay length, cargo dwell time, pre-berthing waiting time, vessel turnaround time, truck turnaround time, crane productivity, cargo handling charge, and shipping connectivity index in their bid to select a port in the region. Using a scale of 1 to 10, the mean weights and the standard deviations of each of the competitive variables were determined. The mean weights of the variables were used to generate the comparison matrix and the priority vector of AHP criteria.

**Comparison of AHP Alternatives**

For a given criterion, the unique scores of the alternative ports were used to form the rows and the columns of the comparison matrix. Computing the priority vector from the resulting comparison matrix yielded a 6x1 matrix.

This procedure was repeated for each of the criteria to yield the priority vectors. The priority vectors were brought together to obtain a 6x11 matrix of the Eigen vector of the alternatives. With the elements of this matrix, one can infer how each of the ports fared with respect to each criterion.

**Overall Competitiveness of the Ports**

To determine the aggregate competitiveness of each of the ports, the combined priority vector of the alternatives was multiplied by the Eigen vector of the criteria to yield a 6x1 matrix that showed the overall competitiveness of each of the ports.

### 4.0 Data Presentation

Table 4.1 is the presentation of the data obtained from questionnaire administered to a sample of 450 respondents comprising the shippers, freight forwarders, shipping company personnel and academic and research professionals in West Africa. Delphi method was deployed in selecting the respondents. The survey target was met by administering at least 25 questionnaires around each port. However, only 392 respondents completed and returned the questionnaire. It contains the lowest rank, the highest rank, the mean and the standard deviation associated with the weights or levels of importance of the factors or determinants of port selection. From the mean of the factors, port throughput is of greatest importance with a score of 7.1235. Closely behind it are vessel turnaround time and cargo handling charge with scores of 7.012 and 6.9033 respectively. The factors with the highest dispersion are port throughput, port draught and quay length with their respective scores of 2.9231, 2.3688 and 2.1187. The mean scores of these port choice factors were deployed in generating the comparison matrix and computing the priority vector of the criteria for port competitiveness in the AHP analysis

Table 4.1: Relative Weights of Port Selection Criteria

| S/N | Port Selection Factors | Lowest Rank | Highest Rank | Mean Rank | Standard Deviation |
|---|---|---|---|---|---|
| 1 | Port throughput (Tonnes) | 2 | 10 | 7.1235 | 2.9231 |
| 2 | Vessel Traffic | 3 | 9 | 6.6114 | 1.9551 |
| 3 | Port draught (m) | 2 | 9 | 5.5203 | 2.3688 |
| 4 | Quay length (m) | 2 | 8 | 4.6315 | 2.1187 |
| 5 | Cargo dwell time (days) | 3 | 7 | 4.9327 | 1.3703 |
| 6 | Vessel pre-berth waiting time (hours) | 3 | 9 | 5.9014 | 1.9120 |
| 7 | Vessel turnaround time (hours) | 5 | 9 | 7.0122 | 1.4907 |
| 8 | Truck turnaround time (hours) | 3 | 9 | 5.1108 | 1.5951 |
| 9 | Crane productivity (tonnes/hour) | 4 | 9 | 6.6501 | 1.5776 |
| 10 | Cargo handling charge (per tonne) | 5 | 9 | 6.9033 | 1.5951 |
| 11 | Liner shipping connectivity index (LSCI) | 3 | 7 | 4.8103 | 1.3166 |

Source: Authors field work

The secondary data in table 4.2 were obtained from the abstract of ports statistics of West African seaports for analysing the pattern of competition experienced by the port in the West African Coast region. Some of the data were also gotten from the ports' websites, the World Bank and United Nations Conference on Trade and Development (UNCTAD).

Table 4.2: Data on port competitive factors

| S/N | Ports | Port Throughput (tonnes) | Frequency of Vessel calls | Draught (m) | Quay Length(m) | Cargo Dwell time(days) | Vessel Pre-berth Waiting Time (hours) | Vessels Turnaround Time (hours) | Truck Turnaround Time(hours) | Crane Productivity (tonnes/hour) | Cargo Handling Charge per ton | Liner Shipping Connectivity Index (LSCI) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Apapa | 21,730,426.0 | 1,498.0 | 9.3 | 3,459.0 | 21.0 | 36.0 | 136.8 | 6.0 | 15.0 | 10.5 | 32.7 |
| 2 | Tin-Can | 16,103,981.0 | 1,725.0 | 9.5 | 4,763.0 | 20.0 | 34.0 | 103.2 | 5.0 | 13.8 | 10.5 | 32.7 |
| 3 | Delta | 8,930,367.0 | 498.0 | 6.2 | 6,286.7 | 23.0 | 32.0 | 93.6 | 14.7 | 8.0 | 10.5 | 32.7 |
| 4 | Onne | 23,478,848.0 | 820.0 | 10.8 | 4,912.0 | 14.0 | 24.0 | 62.4 | 4.2 | 14.0 | 10.5 | 32.7 |
| 5 | Rivers | 4,924,857.0 | 447.0 | 7.6 | 2,369.0 | 23.0 | 38.4 | 184.8 | 16.2 | 11.0 | 10.5 | 32.7 |
| 6 | Calabar | 1,718,518.0 | 197.0 | 6.2 | 1,003.5 | 20.0 | 34.0 | 163.2 | 15.4 | 8.4 | 10.5 | 32.7 |

Source: Abstract of ports statistics, Port websites, UNCTAD and World Bank statistics (2015-2021)

Table 4.3: Priority vector of AHP criteria

| Ranks | Variables | Priorities |
|---|---|---|
| **1** | Throughput Port | **0.10924** |
| **2** | Vessel Turnaround Time | **0.10754** |
| **3** | Cargo Handling Charge | **0.10587** |
| **4** | Crane Productivity | **0.10198** |
| **5** | Vessel Traffic | **0.10139** |
| **6** | Pre-berthing Waiting Time | **0.09050** |
| **7** | Draught | **0.08466** |
| **8** | Truck Turnaround Time | **0.07838** |
| **9** | Cargo Dwell Time | **0.07565** |
| **10** | Shipping Connectivity Index | **0.07377** |
| **11** | Quay Length | **0.07103** |

$\hat{W}_1$ =

Source: Author

A comparison matrix of the AHP criteria that yielded the priority vector presented in table 4.10. From the values of the priorities, port throughput is the factor that is of the highest importance in port selection. The next in that order is vessel turnaround time, cargo handling charge, crane productivity, vessel traffic, pre-berthing waiting time, draught, truck turnaround time, cargo dwell time, shipping connectivity index and quay length

3. Port Draught

| Ranks | Alternatives | Priorities |
|---|---|---|
| 1 | Onne | 0.217741 |
| 2 | Tin-Can | 0.191529 |
| 3 | Apapa | 0.187498 |
| 4 | Rivers | 0.153223 |
| 5 | Delta | 0.125005 |
| 6 | Calabar | 0.125005 |

**4.2 Comparison of AHP Alternatives with Respect to the Competitive Criteria**

1. Cargo throughput

| Ranks | Alternatives | Priorities |
|---|---|---|
| 1 | Onne | 0.217741 |
| 2 | Tin-Can | 0.191529 |
| 3 | Apapa | 0.187498 |
| 4 | Rivers | 0.153223 |
| 5 | Delta | 0.125005 |
| 6 | Calabar | 0.125005 |

2. Vessel traffic

| Ranks | Alternatives | Priorities |
|---|---|---|
| 1 | Tin-Can | 0.332688 |
| 2 | Apapa | 0.288917 |
| 3 | Onne | 0.158153 |
| 4 | Delta | 0.096036 |
| 5 | Rivers | 0.086213 |
| 6 | Calabar | 0.037993 |

4. Quay Length

| Ranks | Alternatives | Priorities |
|---|---|---|
| 1 | Delta | 0.275813 |
| 2 | Onne | 0.215506 |
| 3 | Tin-Can | 0.208966 |
| 4 | Apapa | 0.151754 |
| 5 | Rivers | 0.103937 |
| 6 | Calabar | 0.044024 |

5. Cargo Dwell Time

| Ranks | Alternatives | Priorities |
|---|---|---|
| 1 | Onne | 0.233427 |
| 2 | Tin-Can | 0.163399 |
| 3 | Calabar | 0.163399 |
| 4 | Apapa | 0.155618 |
| 5 | Delta | 0.142079 |
| 6 | Rivers | 0.142079 |

6. Pre-berthing Waiting Time

| Ranks | Alternatives | Priorities |
|---|---|---|
| 1 | Onne | 0.224548 |
| 2 | Delta | 0.168411 |
| 3 | Tin-Can | 0.158501 |
| 4 | Calabar | 0.158501 |
| 5 | Apapa | 0.149698 |
| 6 | Rivers | 0.140342 |

7. Vessel Turnaround Time

| Ranks | Variables | Priorities |
|---|---|---|
| 1 | Onne | 0.290067 |
| 2 | Delta | 0.193374 |
| 3 | Tin-Can | 0.175393 |
| 4 | Apapa | 0.132312 |
| 5 | Calabar | 0.110904 |
| 6 | Rivers | 0.09795 |

8. Truck Turnaround Time

| Ranks | Variables | Priorities |
|---|---|---|
| 1 | Onne | 0.297824 |
| 2 | Tin-Can | 0.250167 |
| 3 | Apapa | 0.208472 |
| 4 | Delta | 0.085098 |
| 5 | Calabar | 0.081221 |
| 6 | Rivers | 0.077218 |

9. Crane Productivity

| Ranks | Variables | Priorities |
|---|---|---|
| 1 | Apapa | 0.21368 |
| 2 | Onne | 0.199427 |
| 3 | Tin-Can | 0.196585 |
| 4 | Rivers | 0.156691 |
| 5 | Calabar | 0.119661 |
| 6 | Delta | 0.113955 |

10. Cargo Handling Charge

| Ranks | Variables | Priorities |
|---|---|---|
| 1 | Apapa | 0.166667 |
| 1 | Tin-Can | 0.166667 |
| 1 | Delta | 0.166667 |
| 1 | Onne | 0.166667 |
| 1 | Rivers | 0.166667 |
| 1 | Calabar | 0.166667 |

11. Shipping Connectivity Index

| Ranks | Variables | Priorities |
|---|---|---|
| 1 | Apapa | 0.16666667 |
| 1 | Tin-Can | 0.16666667 |
| 1 | Delta | 0.16666667 |
| 1 | Onne | 0.16666667 |
| 1 | Rivers | 0.16666667 |

| | | |
|---|---|---|
| 1 | Calabar | 0.16666667 |

Source: Author

Each priority vector shows how the alternative ports fared in each of the competitive criterion.

Table 4.4: The combined priority vectors of AHP alternatives with respect to all the criteria

| | Port Throughput | Vessel Traffic | Draught | Quay Length | Cargo Dwell Time | Pre-berthing Waiting Time | Vessel Turnaround Time | Truck Turnaround Time | Crane Productivity | Cargo Handling Charge | Shipping Connectivity Index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Apapa** | 0.18750 | 0.28892 | 0.18750 | 0.15175 | 0.15562 | 0.14970 | 0.13231 | 0.20847 | 0.21368 | 0.16667 | 0.08137 |
| **Tin-Can** | 0.19153 | 0.33269 | 0.19153 | 0.20897 | 0.16340 | 0.15850 | 0.17539 | 0.25017 | 0.19659 | 0.16667 | 0.08137 |
| **Delta** | 0.12500 | 0.09604 | 0.12500 | 0.27581 | 0.14208 | 0.16841 | 0.19337 | 0.08510 | 0.11396 | 0.16667 | 0.08137 |
| **Onne** | 0.21774 | 0.15815 | 0.21774 | 0.21551 | 0.23343 | 0.22455 | 0.29007 | 0.29782 | 0.19943 | 0.16667 | 0.08137 |
| **Rivers** | 0.15322 | 0.08621 | 0.15322 | 0.10394 | 0.14208 | 0.14034 | 0.09795 | 0.07722 | 0.15669 | 0.16667 | 0.08137 |
| **Calabar** | 0.12500 | 0.03799 | 0.12500 | 0.04402 | 0.16340 | 0.15850 | 0.11090 | 0.08122 | 0.11966 | 0.16667 | 0.08137 |

$$\hat{W}_2 =$$

Source: Author

## 4.2 The Overall Competitiveness of the Ports

Table 4.5: The overall competitiveness of AHP Alternatives with respect to all the criteria

| Ranks | Ports | Priorities |
|---|---|---|
| **1** | **Onne** | **0.21087** |
| **2** | **Tin-Can** | **0.19660** |
| **3** | **Apapa** | **0.17799** |

| | | |
|---|---|---|
| **4** | **Delta** | **0.14473** |
| **5** | **Rivers** | **0.12421** |
| **6** | **Calabar** | **0.10926** |

Source: Author

The overall competitiveness of the ports is a vector product of the priority vector of the criteria and the combined priority vectors of the alternatives given by $(\hat{W}_1 * \hat{W}_2)$. The overall competitiveness of the ports is presented in table 4.5 above. Hence, Onee is the overall most competitive port with a priority score of 0.21087. Tin-Can is the overall second best port in Nigeria with a priority score of 0.19660. The third, fourth, fifth and sixth are respectively Apapa (0.17799), Delta (0.14473, Rivers (0.12421) and Calabar (0.10926)

## 5.0 Results and Discussion

The priority vector obtained from the comparison matrix of the criteria shows that port throughput is the factor that is considered most important by the port operators in the region with a score of 0.10924 (Table 4.3). Following it are vessel turnaround time (0.10754), cargo handling charge (0.10587), crane productivity (0.10198), frequency of vessel calls (0.10139) and pre-berth waiting time (0.09050). The order of importance of the criteria is port throughput > vessel turnaround time > cargo handling charge > crane productivity > frequency of vessel calls > pre-berth waiting time > port draught > truck turnaround time > cargo dwell time > shipping connectivity index > quay length.

The most competitive port with respect to port throughput is Onne, with a score of 0.217741. The second, third, fourth, fifth and sixth are respectively Tin-Can (0.191529), Apapa (0.187498), Rivers (0.153223) Delta (0.125005) and Calabar (0.125005). In terms of the frequency of vessel calls, Tin-Can has the highest score of 0.332688, followed by Apapa (0.288917), Onne (0.158153), Delta (0.096036), Rivers (0.086213) and Calabar (0.037993)

The succinct results of the performances of the ports across the competitive criteria were presented together in section 4.2 as **Comparison of AHP Alternatives with Respect to the Competitive Criteria**

The result of the overall competitiveness of the ports shows that Onne is the most competitive port, pulling 21.087% of the combined attributes considered. It is followed by Tin-Can (19.660%), Apapa (17.799%), Delta (14.473%), Rivers (12.421%) and Calabar (10.926%). Hence, the order of overall competitiveness of the ports is Onne > Tin-Can >Apapa > Delta > Rivers > Calabar

A simple neo-classical model of free market assumes that there are no barriers to market entry, and holds that production and distribution of goods and services in competitive markets maximize social welfare. In other words, competitive free markets deliver allocative, productive and dynamic efficiency (Whish, 2003). These categories of efficiency are highly needed in the port system. This study is in agreement with neo-classical theory by showing that 5 out of the 7 most important factors of competitiveness are efficiency measures.

The results of this study also concur with the findings of many researchers in port competition. Port throughput was found to be the most prominent factor of port selection in the study. Chou (2007) in solving maritime transhipment container port selection problem found that top decision-makers were extremely concerned about the volume of import/export/transhipment containers, cost, port efficiency and location. The findings of Chou (2007) are in agreement with the results of the study.

The order of importance of the port selection factors is port throughput > vessel turnaround time > cargo handling charge > crane productivity > vessel traffic > pre-berth waiting time > port draught > truck turnaround time > cargo dwell time > shipping connectivity index > quay length. In fact 5 out of the 7 most important factors are measures of efficiency. This concurs with the findings of Dyck and Ismael (2015).

### 5.1 Conclusion

Port competition is a serious issue that should not be treated with laxity by any port that wants to be relevant in shipping business. This work has considered the competitiveness of Nigerian ports (Apapa, Tin-Can, Delta, Onne, Rivers and Calabar ),

The major determinants of port competitiveness are vessel traffic, port draught, quay length, cargo dwell time, vessel pre-berth waiting time, vessel turnaround time, truck turnaround time, crane productivity, cargo handling charge and shipping connectivity index.

The best ports with respect to the criteria considered are port throughput (Onne), vessel traffic (Tin-Can), port draught (Onne), Quay length (Delta), cargo dwell time (Onne), pre-berth waiting time (Onne), vessel turnaround time (Onne), truck turnaround time (Onne), crane productivity (Apapa), cargo handling charge (Same across port) and shipping connectivity index (Same across port).

The overall most competitive port is Onne and the least is Calabar. The order of overall competitiveness of the ports is Onne > Tin-Can > Apapa > Delta > Rivers > Calabar

### 5.2 Recommendation

The findings of this research inform the following recommendations:

i. The concessionaires should invest more on better cargo handling equipment to further lower the vessel turnaround time to what is obtainable in the Western ports.
ii. Physical container examination should be replaced with electronic scanners that will ensure the examination of containers in a short while. This is necessary to reduce the high cargo dwell time being experienced in the West African ports
iii. Information and communication technology (ICT) should be fully embraced to attain the speed needed in cargo clearance and also improve the cargo dwell time as a factor of port's competitiveness.
iv. Nigerian ports should embark on a vigorous promotion and image building exercises to restore the confidence of Nigerians and companies that are already routing their cargoes through the neighbouring ports.

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