

Influence of Work Automation on the Performance of Nigerian Ports

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Abstract

The study examined the influence of work automation on the performance of Nigeria ports. The study population was the entire sea-ports in Nigeria. In line with the purpose of study, the study adopted the survey/cross sectional approach. The major research instrument used to collect data was the questionnaire. Thirty (30) copies of questionnaire were distributed to the respondents from the six major sea-ports in Nigeria. The respondents were department heads and senior port managers.

Index terms— work automation, port performance, productivity, cargo throughputs.

1 Introduction

Businesses in the port operations sector have realised that sustainable competitive advantage increasingly depends on the effective use of existing information and the acquisition of consistent data along the entire supply chain. Digitalisation is seen by many as a panacea or necessary step in order to stay competitive. Some have recognised that "getting smarter" is more important than growing in size. The kind of vertical collaboration that improves co-ordination at the intersection of different transport modes is increasingly seen as the new efficiency frontier in port operations. New information and communication technologies (ICTs) such as sensors, communications or software can play a major role in improving this coordination (Kenyon., 2017).

With the possibilities provided by technologies and new data sources, maritime transport stakeholders are seeking new opportunities to extract value-added from more integrated services that cover the entire supply chain. Some of the major players in the shipping industry strive to become integrators of the entire chain, as some carriers seek to take on the role of freight forwarders and further consolidate their position as logistics operators (CMA CGM, 2018). The rationale for vertical integration is obvious as it becomes more and more difficult for shipping companies to generate sustainably competitive margins by reducing maritime costs through bigger vessels (ITF, 2010).

Port authorities around the world increasingly embark on digital strategies that evolve from renters or asset managers to active digital communities. With the need for more efficiency-enhancing coordination in supply chains, port authorities increasingly grow into hubs of physical and information flows among different stakeholders. In the light of growing worldwide competition, ports see the necessity to become more dynamic actors in order to avoid the risk of decreasing significance.

Many bottlenecks in the Nigerian port are related to coordination issues among different stakeholders. For instance, about 48% of container ships arrive more than 12 hours behind schedule and congestion exacerbates costly waiting time in ports (Levander, 2015). According to the ESCAP-World Bank Trade Cost Database, about 60-80% of trade costs worldwide are non-tariff measures of which transport services represent an important part (WEF/Accenture, 2016).

Related inefficiencies, such as trade procedures, business and regulatory practices and constraints, or the insufficient availability and use of information and communication technologies (ICT) contribute to these costs. In terms of paperwork, there may be up to around 200 interactions involving documentation along the supply chain, and the shipper and consignee may deal with as much as 20-30 entities to arrange a shipment (Porter/Lloyd's List, 2017). Many of these interactions are time-consuming and often still take place via phone, fax or email. In this context, the lack of efficient integration of information communication technology makes it difficult to forecast or make effective operational decisions (Kenyon., 2017).

The most valuable tool for bringing cost-cutting efficiency gains and improvements in the overall performance of the ports is the introduction of work automation in port operations. Work automation is introduced into the ports through information communication and technology applications (Cheon, 2007). As public authorities, some see their natural role as a neutral platform that facilitates coordination among different stakeholders. In the light of the above the study evaluated the influence of work automation on performance of Nigerian ports. The research questions investigated in this study included: i/ How does work automation influence productivity of Nigerian ports? ii. How does work automation affect the throughput level of the Nigerian port? Also, the following hypotheses relating to the purpose and problems of the study have been formulated and investigated in this study: Ho 1:

There is no significant relationship between work automations and productivity in Nigerian ports. Ho 2 :

There is no significant relationship between work automations and cargo throughputs in Nigerian ports.

2 II.

3 Literature Review a) Conceptual Framework

There are several dimensions of modern technology that can help in port operations. This study is interested in conceptualizing, classifying and categorizing work automation as an independent variable as the umbrella for the conceptual framework of the study. This conceptualization has been adopted from the earlier works of WEF/Accenture (2016), Osler (2017), Jahn and Saxe (2017) and Kenyon (2017) and this has been depicted in Figure 1:

4 b) Work Automations

Work automation can be defined as the use of integrated technology to develop intelligent solutions for efficient control of traffic and trade flows on the port thereby increasing port capacity and port efficiency (Ayantoyinbo, 2015).

Smart ports (or automated ports) according to Cheon, (2007) generally deploy cloud-based software to assist in creating the operational flows that help the port function smoothly. Currently, most of the ports across the world have technology integrated to some extent, if not for complete management (Ballot, 2016). However, there has been a gradual increase in the number of smart ports, thanks to global government initiatives and the exponential growth of maritime trade. The port of Hamburg, Germany is one such smart port that uses cloud-based solutions for managing energy resources, traffic control, infrastructure facilities, and port property for efficient port operation (Bhandari, 2017).

The degree of automation differs from port to port, depending on the capacity of the port, its location, the amount of cargo it handles, and its economic value. With the growth of mega-ports, the scope of work automation has increased to an unprecedented level.

Here is an overview of what smart ports cover (Ballot, 2016). The evolution of work automation is seen across different avenues. These include material unloading and cargo handling equipment, digitization of ship records, inventory management, building the necessary infrastructure, assisting ship docking and maintenance, and more.

Generally, there are three principal areas of work automation -the gates, the Ship-to-Shore cranes, and the stacks (Bhandari, 2017). Port gates are a key checkpoint for identifying and recording every entity entering or leaving the port. For ships, it also includes additional security checks, verification, customs, immigration, and quarantine. These are crucial tasks, necessary to protect the integrity of the port and require implementation of stringent security measures (Etherisc, 2017). As the volume of container traffic through the port increases, these processes consume a lot of extra time, on account of manual limitations. Automating basic processes, such as entry/exit logs, verification, and docking payments can be done with the help of relevant technology. This makes the entire process flow much smoother and well-organized (ESCAP, 2016).

Logistics management with IoT comes into action during the ship to shore delivery of cargo transported by ships. Use of both, manned and unmanned cranes for unloading is currently prevalent. Across the globe, there are only 30 terminals that can be considered fully automated, when it comes to container transportation (Etherisc, 2017).

Automated cranes are used to deliver the containers from the ships to the port by means of unmanned horizontal transportation or unmanned yard cranes. These are later classified by the type of cargo and stacked accordingly in the inventory. These containers handling systems are stable, predictable, and highly efficient. As the cranes are controlled by a computer, the planning and execution process becomes extremely smooth, achieving the required outcomes in the least possible time (Ducruet, & Merk, 2012).

Once the cargo has been offloaded on the port, it is time for the robots to step in. Cargo handlers and stacking cranes are used to stack the containers as per the category specified. The inventory is often managed by the date of departure inland. As the container is to be dispatched for further transportation, robots are once again used to bring them to the designated station and prep them for the road ahead (Etherisc, 2017).

Safety is one of the major concerns while designing the robotic equipment used to assist in cargo transportation. Smart design takes into account the level of human-machine interaction involved. In addition, the entire process is analysed to optimize inventory flow and ensure that there is no friction between multiple processes (Geloso, 2014).

Technology has wrought an enormous change in the way ports function today. Automated systems, advanced navigation software, remotely-operated cranes, and huge robotic cargo handlers have enhanced port efficiency. But there is the proverbial other side of the coin as well. As the use of technology increases, the role of human labour suffers in comparison. In addition, potential cyber-attacks by people with malicious intentions are a consistent threat. Work automation is seen as the future, but is it worth the cost? Let us objectively analyse the pros and cons of smart ports to find the answer (Ducruet, & Merk, 2012).

The initial investment cost of automation is extremely high. These costs are not affordable for every port, especially in the under-developed and developing nations. As a result, a compromised version of semiautomated ports having technology as a secondary support for manual labour is brought into practice ??Ducruet, & Merk, 2012).

Automation eliminates the human factor involved in the process. This results in the loss of employment of many workers. Labour unions do not react well to automated systems, for obvious reasons. The transition from employed workers to employed supervisors can be difficult and can create problems during the implementation of automation (Bhandari, 2017). Cyber security is a growing threat for megaports with complete or almost-complete automation. Despite having secure information sharing methods, automated systems are susceptible to malware attacks and loss of sensitive data. A breach in security can result in great losses for the port and is hence a problem with work automation (DHL/Cisco, 2015).

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Automated systems need to be updated at regular intervals, to keep up with advancements in the software used. Ignoring updates can result in fatal security breaches, which is why all systems need to be upgraded. This implies continuous maintenance costs for ports ??Ducruet, & Merk, 2012).

Work automation should be taking into account the needs of shipping companies as well as the companies whose cargo is actually being transported across the seas. Technology has been immensely helpful in improving the order and operational productivity of ports (Heaver, 2015).

Therefore, in the field of ICT, a person who is responsible for ICT facilities is called a system administrator. The System Administrator (SA) is responsible for effective provisioning, installation /configuration, operation, and maintenance of systems hardware and software and related infrastructure. This individual ensures that system hardware, operating systems, software systems, and related procedures adhere to organizational values, enabling staff, volunteers, and Partners (Ballot, 2016).

Investment in ICT facilities including software and hardware has been given consideration to many organizations regarding to their operations. Initial implementation of ICT facilities may involve a lot of money and an organization can incur loss, but in a long run an organization may get a lot of profit. However, the cost of investing ICT may include buying new products, repairing and running cost (Kenyon, 2017). The impact of ICT investment on performance has become a matter of both academics and practitioners like Etherisc (2017).

6 c) Performance of Nigerian Ports

Badejo, (1994) is of the opinion that one of the fundamental issues affecting freight operations in Nigeria is lack of coordinated efforts between and within freight modes and operations. Most ports are not linked with dependable road and rail networks. This in turn hampers transport of heavy and extra-ordinary traffic, (Geloso, 2014). Rapu and Ayoade, (1996) stated that one of the most important blocks of sound economic performance is the efficient delivery of goods and materials as quickly and cheaply as possible freight transport plays a key role in the economic development of both developed and developing countries of the world. Freight transport demand is a derived demand which is generated only by inputs to or outputs from agriculture, mining, construction or sea ports industry by purchasing or sales. Thus, the demand for freight is related to economic growth whether it is measured in terms of output expenditure or income.

Over the years the traffic through the Nigerian ports are increasing along with the economic development of the country. It is frequently observed that queues of arriving ships are formed and sometimes ships have to wait for a longer time before berthing. This can be attributed firstly, to the mobility of the existing port facilities to match the ever increasing global trade and secondly, some obnoxious government policies and regulations. This incessant congestion in our ports has resulted in diversion of ships meant for Nigeria ports to other neighbouring country ports. In the reforms and concessioning of 2006, Tin-Can Island Port was concessioned to four different private organizations to manage. defined port congestion as massive un-cleared cargo in the port, resulting in delay of ships in the seaport. According to him, this occurs when ships spend longer time at berth than usual before being worked on or before berth. Onwumere (2008) made mention of port congestion as a situation where in a port; ships on arrival spend more time waiting to berth. In this scenario, more ships will queue at the channels and the outside bar waiting to get space at the terminal for berth age. According to him this waiting time is calculated using the service time of vessels which is one of the ways of measuring port efficiency. His view was that this is a situation whereby cargoes coming into the port are more than the storage facilities can handle.

Port congestion is a global phenomenon not limited to only Nigeria. In 2005 global map of congestion around the world Africa inclusive, the West Coast of Africa including Nigeria was there, the Eastern part of Africa, around Kenya, Southern part of Africa even the West Coast of the United States of America was there several

factors attributed to this Zhang et al (2008). highlighted the factors responsible for port congestion in Nigeria and suggested ways to control congestion at the ports. According to him, there are advantages and disadvantages in port congestion. He said port congestion brought about realization for better planning, port expansion and development. He cited loss of revenue, unemployment and bad image to the country as its major disadvantages.

Tom (2009) is of the opinion that Nigeria should be warned about reoccurrence of congestion in its port. According to him in spite of the various waivers conceded by the government the dwell time of consignment in the port is gradually jerking up against expected time. He cited the use of manual clearing process as one of the major factors responsible for the reoccurrence of the looming congestion.

Tatcchia et al (2008) has observed that performance operations in most ports of developing nations to be frustratingly slow. However, literatures have substantiated knowledge of logistics as an (2010) is of the opinion that adequate logistics management is the road map involved in the design of efficient and effective configuration of two important flows information and product which often facilitate distribution of a firm's products and services at the right place, right time and right price. Onwumere (2008) is of the opinion that conducive environment is a prerequisite for an efficient logistics system. And any country lacking a good base network of dependable transportation, warehousing communication and other related facilities would hardly be able to configure activity network for sustainable economic survival and development. Most less development countries like Nigeria lacks the expertise needed for crafting environment conducive for the development of good logistics system, have are unable to attract foreign investment a pivotal potential to global business strategy for sustainable competitive advantage.

Ogunsiji (2002) is of the opinion that South African's increasing competitiveness and her ability to attract more foreign investment relative to her other African neighbours like Nigeria. With the recent increasing globalization of business, of improved logistics and management, ports are assuming strategic dimension in international business. Any country bereft of ideological redefinition of her distribution network and port logistics performance in this dynamic and ever changing global competitive market will ultimately be left lagging behind. The speedy accessibility of any container port relates to the potential for the movement of containerized cargoes to and for the ports via the networks, i.e. cargo, through put is significantly and positively related to its degree of accessibility to other shipping services (Osler, 2017).

Somuyiwa and Adebayo (2011) defined infrastructure as a part of a structure, material or economic base of a society or an organization. Therefore, infrastructure can be seen as the basic structure that fosters the good performance of cities, states or countries essential services. Infrastructure as defined above can be understood as the basic structure directly responsible for the efficient functioning of the transport systems and others that support a country's economic development. Thus, the fundamental factors to competitiveness are established by economic performance, government, business and infrastructure efficiency. Statistics show that Nigeria pays over \$2 billion in freight each year to foreign ship owners either to export oil to import finished goods. He is of the opinion that off shore rigs and support vessels, coastal cabotage trade and import and export trade amounts to well over \$20billion. The consensus is that if Nigeria can gain a foothold in its shipping industry. The potentials will be enormous, the potentials include the followings, namely job creation, foreign exchange earnings, wealth creation and indigenous shipping capacity.

Egharevba (2011) posited that Nigerian Ports Authority desire to change is borne out of the need to embrace global best practice that is to be the best not only in the sub region but indeed in Africa as a whole. She further stated that the proposed Ports Community System (PCS) in what Nigerian Ports Authority has been yearning for. She added that the organization expects the system to generate data directly from the vessels while also helping to solve truck management and control especially in the area of truck congestion at the port gate after clearance.

Iweala (2011) stated that the Federal Government has mandated all the agencies driving port operations; including the Nigerian Customs Service (NCS) to commence 24 hours service, seven days a week at the nation's ports. Customs and other port operators that now work from 9 am to 5pm would start working round the clock, so that Nigerian ports could operate like ports in other parts of the world. The objective of the above stated efforts is to reduce the time spent on clearing goods from months to 21 days and finally to 48 hours clearing in the long run. To ensure 24 hours clearing of cargoes in the port, the issue of power supply at various terminals must be addressed. Terminal operators have complained that power supply at various facilities is dependent on their own generating set and not electricity which is to be supplied by Nigeria Ports Authority as enshrined in the concession agreement (Evander (2011)).

The output of a port as a service facility providing the means of exchanging commodities between land and maritime transport can be measured in terms of its throughput; the amount of traffic that passes through it in a given time. Productivity is then throughput divided by the amount of factor or factors of production involved in achieving the output. Generally, any of the inputs associated with a given productive effort can be used in the denominator of the productivity ratio. The three traditional factors of production are land, labour and capital. Element of these three factors of production can be used in measurement of port operational productivity. Port productivity can be evaluated from the stand point of the various factors of production labour, infrastructure and equipment in relation to cargo throughput. Analysis of port productivity is a prerequisite for proper port management both for current operations and for planning the replacement of equipment and for investment in new facilities.

7 d) Productivity

Productivity is the quantitative relationship between output and input, productivity is a measure of output to some index of input use. Arithmetically productivity is nothing more than the arithmetic ratio between the amount produced and the amount of any resources used in the course of production. This conception of productivity goes to imply that it can indeed be perceived as the output per unit input or the efficiency with which resources are utilized. Labour which is the most commonly used among the factors of production may be taken as the dock labour input in port operation or the total size of personnel, (unskilled, semiskilled, skilled and managerial staff) engaged in port services. It is more usual to define port labour productivity in terms of actual dock labour engaged in cargo work on the quays. Capital also relates to the stock of equipment, plants and other mechanical handling aids used in port operations on which the enhanced productivity of labour much depends. Port productivity has been discussed and argued by many scholars since the emergence of containerization for more than three decades have evolved a lot of development. The most important objective of a port is to decrease or increase throughput (Ducruet & Merk, 2012). As a result, the turnaround of vessel depends on effective allocation and scheduling of key resources such as quay cranes, berths trucks and yard cranes. Ayatoyinbo, (2015) already foresaw this scenario when he stated that careful planning is necessary for obtaining satisfactory results.

Zhang et al, (2008) argued that most researches conducted on port productivity are based on quantitative measures, as it is easier in assessing port performance. Ports are service oriented; therefore, efficiency is very crucial in determining moves per hour for loading and discharging container from and onto vessel. Some researchers have researched into port performance and productivity; they were able to show the critical aspect of productivity in terminals (Ogunsiji, 2010; Levander, 2015; and Kenyon, 2017).

Since the current scenario of world trade goes to cellular vessels, thus the demand for transportation of goods via sea increases tremendously. In view of this, more and more terminals are expanding in order to cater for available demand. Terminals are facing challenges on productivity with more and larger vessels in the shortest possible time. Gharevba (2011) As a result, in order to obtain operational efficiency, there are three aspects between planning and control level which can be segregated into strategic level, tactical level and operational level (CMA CGM, 2018). This shows that terminal operators need to enhance their planning and operational capability by deploying innovative and state of the art equipment in order to optimize terminal operational process. In order to optimize terminal resources, it is vital to ensure that port terminal operational flow is able to operate smoothly.

Whereas in 2000's most research in port productivity are been narrowed in scope by focusing on terminal equipment such as yard crane and truck (ITF, 2010) quay crane (Zhang et al., 2008; and rubber tyre gantry crane (Zhang et al., 2002). They focused on these aspects to ensure that terminal operators are able to maximize these kinds of equipments. In maritime subsector, Cheon, (2007) described that port productivity and performance is measured in terms of the number of containers moved through a port, known as cargo throughput, on the assumption that the ports are throughput maximizers. World Bank (2016) was of the opinion that port performance indicators are based on economic perspective. As far as shipping industry is concerned, port performance measurement is important to everyone who involves in shipping.

8 e) Cargo Throughputs

It is worthy of note that average cargo throughput from 1956 to 2005 is 14,467,024 metric tons while the average cargo throughput from 2006 to 2012 is 67,240,231.86 metric tons. The yearly average cargo throughput of 67,240,231.86 metric tons of cargo from 2006 to 2012 over the yearly average of 14,467,024 metric tons from 1956 to 2005 shows a percentage increase of 456.69%. This shows the remarkable progress made in our port developmental efforts since the port concession era. In a nutshell, the pattern in Nigerian port traffic during the pre-concession era is sinusoidal while the post concession experienced a sharp progressive rise. The statistics on Table 2 shows that the cargo throughput increased from 46,150,518 metric tons in 2006 to 77,104,738 metric tons in 2012. This means that between 2006 and 2017, cargo throughput at the nation's ports increased by over 67 per cent. This was as a result of the landlord model of port management which was adopted in 2006 that led to the concession of sections of the ports to private terminal operators, otherwise called concessionaires, and has led to the consistent improvement in cargo throughput. Table 1 shows the inward cargo trend from 1961 to 2017. It follows the same pattern like the cargo throughput trend. The trend of cargo throughput follows the same pattern as import trend. It means then that the trend of cargo throughput is greatly determined by the trend of import or inward cargo movement. In a nutshell, the pattern in Nigerian port traffic during the pre-concession era is sinusoidal while the post concession experienced a stable and continuous growth as indicated with the blue line. The trend concurs with that witnessed in total cargo throughput which is clear evidence that the pattern of Nigeria's port traffic is controlled by imports. During the period 1961-2017 import traffic overwhelmed exports. trend was analogous which means there was no improvement in export activities. However, small improvement was recorded from 1971-1974 with a slight upward tilt of the trend line. The situation reversed to the parallel trend from 1975-1987. This means that there was a downward tilt of the trend line. The period 1988-1999 witnessed a slight improvement in export activities with a slight upward tilt of the trend line while the trend line experienced a sharp upward movement from 2000-2017 (UNCTAD, 2018).

Table 1 shows the volume of cargo throughput handled at the Nigerian ports from 1956 to 2012. Cargo throughput is the sum of both the inward and the outward cargo processed by the ports in the given period.

There was a slow growth in cargo traffic from 1956 to 1974; and the fall noticeable in-between 1966 and 1970, as a result of the civil war, was not enough to utterly obscure the growth trend. The rise in traffic between 1975 and 1979 was significant although the rise began in 1970. The abrupt rise was not preceded by port development sufficient enough to handle the traffic. The result was the 1975-1978 congestion problems which stemmed from the massive importation of cement called 'cement armada' and other construction material for the rehabilitation of infrastructure destroyed by the civil war. Traffic dropped from 20,075,237 metric tons in 1979 to 17,957,195 metric tons in 1980, peaked again in 1981 and then suffered serious decline that coincided with the global economic recession. This downward trend can be ascribed to the austerity measures introduced by the then government with the view to revamping the ailing economy. The downward trend continued for about nine years with the total cargo throughput in 1989 falling to 13,376,187 metric tons. The traffic picked up again in 1990 only for a brief period as it fell during the country's political uncertainty of 1992 and 1993. Since 1996 there has been a rapid rise in cargo throughput culminating in an unprecedented volume in 2016 with a slight decline in 2017 (Nigerian Ports Authority, 2019).

9 III.

10 Theoretical Framework a) Instrumental Theory

The theoretical starting point for the study analysis is the well-established literature on new technology adoption. This literature points to delays in the adoption of new technologies and differences in adoption rates across firms, industries and countries (Gallea, Ghobadian & O'Regan, 2008). The existing theoretical models focus on a number of factors explaining this delay and the variation in the adoption rates including uncertainty about the characteristics of the new technology.

Instrumental theory offers the most widely accepted view of technology. It is based on the common sense idea that technologies are "tools" standing ready to serve the purposes of their users. Technology is deemed "neutral," without evaluative content of its own. However, what does the notion of the "neutrality" of technology actually mean? The concept usually implies at least four points. First technology, as pure instrumentality, is indifferent to the variety of ends it can be employed to achieve (Levander, 2015). Thus, the neutrality of technology is merely a special case of the neutrality of instrumental means, which are only contingently related to the substantive values they serve.

This conception of neutrality is familiar and self-evident. Secondly, technology also appears to be indifferent with respect to politics, at least in the modern world, and especially with respect to capitalist and socialist societies. A hammer is a hammer, a steam turbine is a steam turbine, and such tools are useful in any social context. In this respect, technology appears to be quite different from traditional legal or religious institutions, which cannot be readily transferred to new social contexts because they are so intertwined with other aspects of the societies in which they originate (Gallea, Ghobadian & O'Regan, 2008).

The transfer of technology, on the contrary, seems to be inhibited only by its cost. Thirdly, the sociopolitical neutrality of technology is usually attributed to its "rational" character and the universality of the truth it embodies. Technology, in other words, is based on verifiable causal propositions. Insofar as such propositions are true, they are not socially and politically relative but, like scientific ideas, maintain their cognitive status in every conceivable social context. Hence, what works in one society can be expected to work just as well in another. Lastly, the universality of technology also means that the same standards of measurement can be applied in different settings (Bitner, Brown, & Meuter, 2000). Thus, technology is routinely said to increase the productivity of labor in different countries, different eras and different civilizations. Technologies are neutral because they stand essentially under the very same norm of efficiency in any and every context. Given this understanding of technology; the only rational stance is unreserved commitment to its employment. Of course, we might make a few exceptions and refuse to use certain devices out of deference to moral or religious values.

Reproductive technologies are a case in point. Even if one believes that contraception, abortion, test tube babies are value neutral in them, and, technically considered, can only be judged in terms of efficiency, one might renounce their use out of respect for the sacredness of life (Bitner et al., 2000). This approach places "trade-offs" at the center of the discussion. The instrumentalist understanding of technology is especially prominent in the social sciences. It appears to account for the tensions between tradition, ideology and efficiency, which arise from socio-technical change. Modernization theory, for example, studies how elites

11 b) Resource Based Theory

Resource based theory (RBT) has been used by different scholars whose attention is in studying ICT impacts and organization performance. As Ayantoyinbo (2015) noted, RBT was pioneered by and it has in recent years gained popularity in ICT research studies. Different scholars, for example, Ducruet & Merk (2012); Baradwaj (2010) argue that the unique resources are the main sources of competitive advantage and organization performance. Researchers have identified various ICT resources, such as IT capabilities, IT infrastructures and IT human resources (Baradwaj, 2010). While according to Somuyiwa and Adebayo (2011), assert that IT-enabled supply chain capabilities, which are firm-specific and hard-to-copy across organizations. These capabilities can serve as a catalyst in transforming IT-related resources into higher value for a firm. DHL/Cisco (2015) defined resources as stocks of available factors that are owned or controlled by the firm. Based on previous studies;

ICT resources in this study are defined as a multidimensional term which integrates software and hardware which enhance telecommunication functions. These infrastructure (application, data, server and network), ICT personnel (people who posed technical know-how), ICT capital (cost of implementing and running ICT in an organization).

12 c) Empirical Studies

Previous studies on modern technology and ports' performance have mixed results; some argue that IT is an alternative paradigm to ports' performance, while some disagree. For instance, Bhandari (2017) examines the impact of the technology on logistics and supply chain management. The author mainly focuses on the secondary data for collecting data relating to various technology used in logistics and supply chain management. The author draws conclusion that technology is a vehicle to enhance supply chain competitiveness and performance by enhancing the overall effectiveness and efficiency of logistics system.

Heaver (2015) also examine the effects of information technology on Port performance in Nairobi Kenya to realize its significant impact on their operations in order to guarantee their profitability and growth. Data was collected from 10 firms in the logistic industry suppliers in Nairobi. The data was analyzed with the aid of SPSS and result shows that there is a strong relationship between IT and the performance of logistic firms in Nairobi County.

In another study, John and Saxe (2017), determine the effect of information technology on port's warehouse management. The researcher used descriptive research design taking Jomo Kenyatta University of Agriculture and Technology as a case for this study. The target population was 930 and a sample size of 50. The sampling design adopted was stratified random sampling. Data collection was done by use of questionnaire and informal interviews. Result indicates that information technology has positive effect on port's warehouse management. Similarly, Somuyiwa and Adebayo (2011), also examine the impact of ICT usage on logistics activities of sea ports companies in Southwestern Nigeria. Both descriptive and inferential statistics were employed to analyze the data. The study reveals that ICT has strong relationships between with Logistics activities.

Also, Chieh-Yu and Yi-Hui (2007) investigate the impact of technological innovation on the performance of China's Logistics Industry. The paper employs the questionnaire survey to study the factors influencing the adoption of technological innovations by logistics service providers in China as well as the influences of technological innovation on supply chain performance. ??2000), also provide empirical evidences indicating that technology has the potential to improve overall port capabilities. The study indicates that IT is a high priority for 3PL users. IT capabilities also are seen as exceptionally critical to the integration of logistics services provided by 3PLs (Baradwaj, 2010). Also, Mzoughi, Bahri and Ghachem (2008) investigate the impact of supply chain management and Enterprise Resource Systems (ERP) on organizational performance and competitive advantage in Tunisia by conducting a survey on 216 Tunisian managers. Their results show the importance of SCM and ERP systems adoption as well as reveal their positive impact on organizational performance and competitive advantage in Tunisians companies. However, the findings of Bhandrai (2017) and Zakaria, Zailani and Fernando (2010) are contrary the previous studies, their studies reveal that information technology had no moderate effects on the ports' performance. In another study, Wu, Sengun, Daekwan and Tamer (2006) argue that making investments in modern technology does not necessarily guarantee the increase of enterprise performance.

13 Methodology

The research design applied in this study is the survey research design. .In the context of the study, the target population consisted of top level managers from all the six (6) ports in Nigeria Port Authority namely: Tin can Island Port, Apapa Port, Onne Port, Warri Port, Port Harcourt Port and Calabar Port. The major research instrument used was the questionnaire. Thirty (30) copies of questionnaire were distributed to the respondents from the six major sea-ports in Nigeria. The respondents were department heads and senior port managers. Reliability refers to whether a repetition of the study would give the same results or not. In this study, the reliability was confirmed by conducting a confirmatory test of internal consistency on the instrument with our sample, using the Crombach alpha value with the aid of the computerize SPSS software. Hence, only result of 0.7 and above were considered acceptable. As revealed in Table 3, the result on the Cronbach Alpha reliability for the instruments on the variables demonstrate all instruments as having good reliability scores. This is demonstrated by the Cronbach Alpha coefficients which are all revealed to surpass the 0.7 threshold for adequate reliability results.

In this study, percentages, ratios, frequency distribution, scaling, ranking and other statistical tools were used to analysedata. Also, Pearson Product Moment Correlation Coefficient (r) and t-test would be used to test the hypotheses formulated in the study.

14 Decision Criterion

Reject (Ho) if computed t is greater than or equal to the t value obtained from the statistical table at a corresponding level of significance of 5% then the alternative hypothesis (Hi) is accepted; but, if otherwise (Hi) is rejected and Ho accepted ??Ali, 2006).

All these analyses shall be computed by using statistical package for social sciences (SPSS) version 22.0. Table 5 shows that there are more male, 24, representing (80%) than female 6, representing (20%) of the respondents. Although the frequency is so far from to each other, this finding simply shows that sea ports have more male workers than female. Table 8 presents the job designation (status) of the respondent. From the table above, it will be discovered that 11(37%) of the respondents are the supervisors of their various units. 3(10%) of the respondents are senior Accountants with the port authority while, 16(53%) are senior Managers.

VI.

Results, Analysis and Discussions

a) Hypothesis Testing

In chapter one, in order to provide tentative answers to the research questions, hypotheses were stated in the null form. All the stated hypotheses indicate a bivariate relationship. The hypothesis will be put to test using Pearson product moment correlation (PPMC) analysis.

According to John & Saxe (2017), they posit that it is preferable to and reasonable to combine items measuring the variables into one index in order to operationalize a single dimension of concept. This is called recoding or transformation of variables. The transformed variables will be used to represent the proxies

b) Interpreting Correlation Coefficients

Akujuru and Enyioko (2018) gave a scale for interpreting in semantic terms, the statistical significant of Pearson correlation coefficient of different magnitude. See the table below.

Hypothesis 1 H 01 :

There is no significant relationship between work automation and productivity of the sea-ports in Nigeria. Table 10 presents a coefficient of 0.720 which indicated a strong positive relationship between work automation and productivity and it is statistically significant. This infer that the null hypothesis should be rejected which infers that there is no significant relationship between work automation and productivity of Nigeria sea-ports and accept the alternative.

Hypothesis 2

H 02 : There is no significant relationship between work automation and throughput level of sea-port in Nigeria. Table 11 presents a correlation coefficient of 0.520. By interpretation, this is a moderately positive relationship between work automation and throughput level of the Nigeria sea-port. The coefficient is statistically significant hence we reject the null hypothesis which infers that there is no significance relationship between work automation and throughput level of the sea-ports in Nigeria and accept the alternative.

VII.

Discussion of Findings

The study explored the relationship between work automation and performance of sea-ports in Nigeria.

The study adopted the usage of work automation which also became the independent variable and dimension of the study. This has become obvious in cognizance with Closs and Kefeng (2000), who also provide empirical evidences indicating that work automation has the potential to improve overall port capabilities. The measures of port performance were productivity and throughput level of the sea-ports in Nigeria. These measures were found to be in consonance with some of the major key performance indicators for measuring performance of sea-ports all over the world (Closs & Kefeng, 2000).

To a very large extent, the study observed that port value increases by giving satisfactory evaluation of work automations/systems and administration. The study observed that to a very large extent, work automations/systems administration are often used as key performance indicators (KPI) in Nigeria port. This is true of the system of administration of all port management authority in Nigeria. To a very large extent, study observed that they give room for the assessment of work automations/systems administration. To a very large extent, the respondents were allowed to make variety of inputs on work automations/systems administration in their various sea-ports. Staff of the ports have the requisite skills to give critical assessment on the issues of work automations/systems administration. These findings are in consonance with the works of Jahn and Saxe (2017) and Wilson, et al (2015).

Staff are involved in open and robust discussions with the management on strategic effect of productivity in the port operation. To a very large extent the study observed that marine port is positively affected by productivity. The study equally observed that productivity is very important for Nigeria ports growth. To a very large extent the findings discovered that cargo throughputs are positively affected by the operations of Nigerian sea-ports. The study further observed that the quality of interaction between staff and customers become positive for the growth of cargo throughputs in Nigerian sea port. To a very large extent the study found out that the increase in

cargo throughputs lead to effective and efficient port operations in Nigeria and to a very large extent the study finally discovered that port operations give rooms to staff to suggest new ways or approaches on how to improve cargo throughputs.

23 a) Summary of Findings

The study investigated the relationship between work automation and the performance of sea-ports in Nigeria. The findings of the study revealed that to a very large extent, work automations are often used as key performance indicators (KPI) in Nigeria port. This is true of the system of administration of all port management authority in Nigeria. To a very large extent, the study observed that ports give room for the assessment of work automations. To a very large extent, the respondents were allowed to make variety of inputs on work automations in their various sea-ports. Staff of the ports have the requisite skills to give critical assessment on the issues of work automations.

The study postulated and tested two hypotheses. Hypothesis one indicated a moderately positive relationship between work automation and productivity and it is statistically significant. This infer that the null hypothesis should be rejected which infers that there is no significant relationship between work automation and service quality of Nigeria sea-ports and accepted the alternate hypothesis. Finally, the result of hypothesis two indicated a moderately positive relationship between work automation and throughput level of the Nigeria sea-port. The coefficient is statistically significant hence we reject the null hypothesis which infers that there is no significance relationship between work automation and throughput

24 Conclusion

Automation is a global trend in port container terminals. However, the level of work automation adopted in each terminal depends on different factors that are inherent to its status of development, the subsystem object of automation, and the yard operating system, among others. Port authorities around the world increasingly embark on digital strategies that evolve from renters or asset managers to active digital communities. With the need for more efficiencyenhancing coordination in supply chains, port authorities increasingly grow into hubs of physical and information flows among different stakeholders. In the light of growing worldwide competition, ports see the necessity to become more dynamic actors in order to avoid the risk of decreasing significance. Conclusively, there is significant relationship between work automations and productivity in Nigerian ports and there is significant relationship between work automations and cargo throughputs in Nigerian ports.

25 IX.

26 Recommendations

Deriving from the findings of the research work, the research recommends have been made as follows;

1. Port managers should improve on productivity orientation of their ports by encouraging the use of efficient work automation in order to improve performance of the port. 2. Port managers should recommend work automation that will improve throughput level of the various seaport so as to improve the income generation activities of port thereby improving the nation's economy. 3. Port managers should recommend the computerization, work automation in such a manner that is in compliance with best practices all over the world so as to improve the throughput of the various sea-ports.

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Global	Year	1961	Inward	1,386,480	Outward	1,356,480	Throughput
Journal	1962	1963	1,620,195		1,552,752		2,742,960 3,172,947
of Man-	1964	1965	1,680,222		1,419,552		3,099,774 3,543,862
agement	1966	1967	1,823,506		1,720,356		3,593,341 3,630,716
and	1968	1969	2,110,440		1,482,901		4,014,518 4,019,006
Business	1970	1971	2,256,453		1,374,263		4,358,306 4,678,500
Research	1972	1973	2,350,087		1,664,431		4,851,461 4,181,906
	1974	1975	2,387,446		1,631,560		3,835,568 3,839,128
	1976	1977	2,527,730		1,830,576		4,227,482 7,309,003
	1978		2,640,672		2,037,828		8,113,104 7,562,239
			2,853,627		1,997,834		
			2,428,106		1,753,800		
			2,272,681		1,562,887		
			2,177,611		1,661,517		
			2,719,518		1,507,964		
			4,492,152		2,816,851		
			5,281,466		2,831,638		
			4,459,164		3,103,075		
	1979		5,256,724		3,218,696		8,475,420
	1980		5,979,492		2,461,934		8,441,426
	1981		8,481,284		2,518,241		10,999,525
	1982		11,853,063		2,552,183		14,405,246
	1983		15,694,964		2,419,808		18,114,772

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[Note: Source: Nigerian Ports Authority (2019). Nigerian Ports Authority Handbook. Lagos. Available online: www.nigerianports.gov.ng (accessed on 16 July 2020).]

Figure 1: Table 1 :

also

, shows

the outward cargo trend from 1961-2017 the export

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Figure 2: Table also

2

NPA PORT	Harbour Dept.	Traffic Dept	Statistics Dept	M & C Depart- ment	Tariff Billing	Total
Lagos Port	1	1	1	1	1	5
Tin Can Island Port	1	1	1	1	1	5
Delta Port	1	1	1	1	1	5
Port Harcourt Port	1	1	1	1	1	5
Onne Port	1	1	1	1	1	5
Calabar Port	1	1	1	1	1	5
						30

Source: Survey Data, 2020.

Figure 3: Table 2 :

3

	Reliability Test	No. of indica- tors	Alpha Coeffi- cient
Variables	Dimension/measures		
Work	Automation	5	0.875
Performance	Productivity	5	0.881
	Cargo throughput	5	0.896
Source: SPSS	22.0 Output and Survey Data, 2020		

Figure 4: Table 3 :

4

Age of respondents	Frequency	Percent
36-45	16	53.0
46-55	11	37.0
55 above	3	10.0
Total	30	100.0

Source: Survey Data, 2020.

Figure 5: Table 4 :

5

Gender	Frequency	Percent
Male	24	80.0
Female	6	20.0
Total	30	100.0

Source: Research survey, 2020.

Figure 6: Table 5 :

6

Work experience	Frequency	Percent
0 -20	16	53.0
21-30	11	37.0
>31	3	10.0
Total	30	100.0

Source: Survey Data, 2020.

Figure 7: Table 6 :

7

Work experience	Frequency	Percent
OND/NCE	3	10.0
BSc/HND	16	53.0
MSc above	11	37.0
Total	30	100.0

Source: Survey, 2020.

Figure 8: Table 7 :

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Figure 9:

8

Position	Frequency	Percent
Supervisors	11	37.0
Accountant	3	10.0
Managers	16	53.0
Total	30	100.0

Source: Research survey, 2020

Figure 10: Table 8 :

9

Correlation coefficient.	Appropriate interpretation
+ .70 to +1.0	Very strong positive relationship
+ .50 to +.69	Substantial positive relationship
+ .30 to +.49	Moderate positive relationship
+ .10 to +.29	Low positive relationship
+ .01 to +.09	Negligible positive relationship
00	No relationship
- .01 to -.09	Negligible negative relationship
- .10 to -.29	Low negative relationship
- .30 to -.49	Moderate negative relationship
- .50 to -.69	Substantial negative relationship
- .70 to -1.00	Very strong negative relationship

Source: Adopted from Akujuru and Enyioko (2018).

Figure 11: Table 9 :

10

Work.Aut	Prod.
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Figure 12: Table 10 :

11

Figure 13: Table 11 :

[Accessed on (2019)] , *Accessed on 2/2019*. 12.

[Rapu and Ayoade ()] *An Overview of Freight Transport in Nigeria: The Policy Options*, O J Rapu , M Ayoade . 1996. W. A. Kadiri.

[Somuyiwa and Adebayo ()] ‘Analysis of Information and Communication Technologies (ICT) usage on logistics activities of sea portscompanies in Southwestern Nigeria’. A O Somuyiwa , T Adebayo . *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)* 2011. 2 (1) p. .

[Ayantoinbo ()] ‘Assessing the impact of Information and Communication Technology (ICT) on the performance of freight distribution’. B B Ayantoinbo . *European Journal of Logistics, Purchasing and Supply Chain Management* 2015. 3 (4) p. .

[Connecting to Compete 2016: Trade Logistics in the Global Economy. The Logistics Performance Index and Its Indicators ()] *Connecting to Compete 2016: Trade Logistics in the Global Economy. The Logistics Performance Index and Its Indicators*, 2016. Washington, DC: World Bank.

[Osler ()] ‘Data is ‘new asset class’, claims Maersk Tankers chief’. D Osler . <https://lloydslist> *Lloyds List Maritime Intelligence* 2017.

[Wef/Accenture ()] ‘Digital Transformation of Industries: Logistics Industry’. Wef/Accenture . *World Economic Forum* 2016.

[Gallear et al. ()] ‘Digital/web-based technology in purchasing and supply management: a UK study’. D Gallear , A Ghobadian , N O’reagan . *Journal of Sea ports Technology Management* 2008. 19 (3) p. .

[Porter (2017)] ‘Digitalisation: Over-hyped or a genuine game-changer for container shipping?’. J Porter . *Lloyd’s List Containers*, 2017. 25 October, 2018.

[Jahn and Saxe ()] ‘Digitalization of Seaports -Visions of the Future’. C Jahn , S Saxe . *Fraunhofer Center for Port operations and Services (CML)*, 2017. p. .

[Wilson et al. ()] ‘Effects on information technology on performance of logistics firms in Nairobi County’. M N Wilson , M A Iravo , O I Tirimba , K &ombui . *International Journal of Scientific and Research Publications* 2015. 5 (4) p. 126.

[Mzoughi et al. ()] ‘Impact of supply chain management and ERP on organizational performance and competitive advantage: Case of Tunisian companies’. N Mzoughi , N Bahri , M Ghachem . *Journal of Global Information Technology Management* 2008. 2 (17) p. 2446.

[Kenyon ()] ‘Improving the return on investment in ports: opportunities in data management’. G N Kenyon . *Maritime Economics and Logistics* 2017. 19 (2) .

[Heaver ()] ‘Increased collaborative relationships in international logistics: Canadian and other national and corporate examples’. Heaver . *Maritime Policy & Management* 2015. 42 (3) .

[Itf ()] *Integration and Competition between Transport and Logistics Businesses*, 22. *ITF Round Tables*, Itf . 10.1787/9789282102619-en. <https://doi.org/10.1787/9789282102619-en> 2010. Paris: OECD Publishing.

[Badejo (ed.) ()] *Maritime Transport in the Nigerian Economy*, D Badejo . D. Badejo (ed.) 1994. Maritime.

[Ogunsiji ()] ‘Measures of Improving ports Logistics Efficiency in Nigeria: A Case Study of Tin 33’. O O Ogunsiji . *Text on Maritime Transport Operations and Management*, (Lagos) 2010. 2008. Certified Institute of Shipping

[Zakaria et al. ()] ‘Moderating role of logistics information technology’. H Zakaria , S Zailani , Y Fernando . *Operations & Supply Chain Management* 2010. 3 (3) p. .

[Iweala (2011)] *Nigeria to Commence 24-hours Port Operations*, O Iweala . <http://www.businessdayonline.com> 2011. March. 26 th 2019.

[Nigerian Ports Authority Handbook. Lagos. Available online: www.nigerianports.gov.ng (accessed on (2019))] *Nigerian Ports Authority Handbook. Lagos. Available online: www.nigerianports.gov.ng (accessed on, 2019*. July 2020. p. 16. Nigerian Ports Authority

[Tatcchia et al. ()] ‘Performance Measurement Management. (PMM) for SME’s ”A Literature Review and a Reference Framework for PMM Design’. P Tatcchia , L Cagnazzob , M Botazreelic . *19th Annual Conference*, (La Jolla, California USA) 2008.

[Maduka ()] *Port, Shipping, Safety and Environmental Management*, Maduka . 2004. Lagos, Concept Publication Ltd.

[Maduka ()] *Port, Shipping, Safety and Environmental Management*, Maduka . 2004. Lagos: Concept Publication Ltd.

[Tom ()] *Reoccurrence of congestion in Nigerian ports*, K Tom . 2009. 15 p. . (port news)

[Unctad ()] *Review of Maritime Transport*, Unctad . 2018. 2018. New York/ Geneva. (United Nations publication)

- 555 [Geloso ()] *Services Trade Restrictiveness Index (STRI): Transport and Courier Services*, G M Geloso . 2014.
 556 Paris: OECD Publishing. 176.
- 557 [Porter (2017)] *Six-month recovery time for Maersk after cyber-attack*, J Porter
 558 . [https://lloydslist.maritimeintelligence.informa.com/LL112257/](https://lloydslist.maritimeintelligence.informa.com/LL112257/Sixmonth-recoverytime-for-Maersk-after-cyber-attack)
 559 *Sixmonth- recoverytime- for-Maersk- after- cyber- attack* 2017. November 2018. 1. (Lloyd's
 560 List Maritime Intelligence)
- 561 [Akujuru and Enyioko ()] *Social science research: Methodology and conceptual perspectives*, C A Akujuru , N C
 562 Enyioko . 2018. Beau Bassin: Lambert Academic Publishing.
- 563 [Zhang et al. ()] 'Storage Space Allocation in Container Terminals'. C Zhang , Y W Linwan , K G Murty , R J
 564 Lin . *Transport Research Part B* 2008. p. .
- 565 [Wu et al. ()] 'The impact of information technology on supply chain capabilities and firm performance: A
 566 resource-based view'. F Wu , Y Sengun , K Daekwan , S C Tamer . *Industrial Marketing Management* 2006.
 567 35 (4) p. .
- 568 [Ogunsiji ()] *The Practice of Strategic Management on small scale industry Performance in Oyo State, Nigeria*,
 569 A S Ogunsiji . 2002. Ogbomosho Nigeria. of Ladoke Akintola University of Technology (Unpublished Doctoral
 570 Thesis)
- 571 [The use of Logistics Information Systems for increased efficiency and effectiveness ESCAP ()] 'The use of Lo-
 572 gistics Information Systems for increased efficiency and effectiveness'. *ESCAP* 2016. (Regional Study)
- 573 [Levander (2015)] 'Towards unmanned ships'. O Levander . *Presentation for Rolls-Royce at Ship Efficiency*,
 574 (London) 2015. 2015. 8 September 2015.
- 575 [Can Island Port and Nigeria] *Unpublished Master's Thesis*, Lagos Can Island Port , Nigeria . Herriot-Watt
 576 University Edinburgh U. K