



ASSESSING SUPPLY CHAIN MANAGEMENT OF FREIGHT IN INTERMODAL TRANSPORT SYSTEM IN NIGERIA

TEMITOPE PAUL BABARINDE¹; OLUSEGUN
ONIFADE ADEPOJU²; AND OGOLA DANIEL
BEKESUOMOWEI³

¹Department of Logistics and Supply Chain Management, Sheffield Hallam University, 153, Arundel St. Sheffield City Centre, Sheffield S1 2NU United Kingdom. ²Department of Transport and Logistics Management, Faculty of Arts, Management and Social Sciences, Nigerian Army University, P.M.B 1500, Biu, Borno State, Nigeria. ³Department of Port Management, Nigerian Maritime University, Okerenkoko, Delta State, Nigeria

ABSTRACT

The movement of goods is crucial to the economic survival of any nation. It is the means by which goods are distributed for consumption, disposition and production. The problem with Nigerian supply chain management of goods is characterized by delay in delivery, bad roads, missing or damages resulting to claims and defective packaging. This paper identified challenges confronting freight movement in supply chain management and determined the delay causative factors in logistics of the selected transportation companies. Lagos State was chosen as

Introduction

The importance of supply chain management can be felt when goods and services are needed and not available. Conveyance of goods to nooks and crannies from raw materials to production site and onward delivery of manufactured products through intermediate points of storage or warehouses are activities involved in supply chain management. There are varieties of goods which must be moved from one place to another for the purpose of consumption, distribution, production or disposition (Somuyiwa and Onifade, 2020). Moving goods from one place to another through transportation must consider available modes of transport, the cost implication, route, taxes, time, reliability and distance. Transportation is very crucial for locational changes as rarely products are produced and consumed in same location (Bureau of Transportation Statistics, 2002). The composite of goods can be raw materials, finished products or semi-finished product and waste products. According to Suksri et al (2012), they observed that, movement of goods plays an important role in economic and social development of a country. In Nigeria, the concept is relatively new and was more commonly known in the 1970s and 1980s as physical distribution



one of the States in Nigeria with the presence of all modes of transportation. Four transportation companies out of seven with Plc. status viz: MPZ Haulge, Muahlb Ltd, STL Logistics, and Ajahi Logistics were selected because they have depots at each geopolitical zone in Nigeria. The composition of supply chain managers and warehouse supervisors and logistics manager were the targeted respondents. Of the 307 respondents of this targeted population, 275 (89.6%) responses were retrieved from systematic random sampling technique of the selected companies. Research instrument was designed through Google forms and collected data was analyzed with One-sample T-test. Secondly, delay causative factors were analyzed with descriptive bar chart. Results revealed the challenges confronting freight logistics and causative delay factors in supply chain management ranging from taxes on the road, civil unrest, documentation, surge in demand and sourcing for trucks. The research concluded with some recommendations for government and companies.

Keywords: Supply chain management, freight, transportation, mode, Nigeria

management. In the late 1980s, the concept evolved to logistics management and in the late 20th century, it evolved into supply chain management with however, very few companies practicing it. It was only recently, when the country is attracting investors, consequently to compete globally, that attention is shifting towards supply chain management in Nigeria. Fajir and Zidan (2016) observed the challenges in transportation in Nigeria and Egypt in form of bad roads, policy issues, management and lack of adequate integration. According to Adepoju (2021) where he attributed reasons Nigerian roads are bad to inability to take care of erosion, scarcity or non-engagement of skilled labour and funding. He buttressed that, challenges in movement in Nigeria results into road crashes, high maintenance cost, capital flight and increase in transportation cost. There is virtually no business or industry untouched by the business of logistics and supply chain management. Getting the right product to the right customer at the right time as efficiently and cost-effectively as possible is the main objective of logistics and supply chain management. This study therefore examined the supply chain activities in Nigeria with a view to identify its challenges and determine the causative factors in the delay of freight movement for possible solution for their optimization using the selected companies as case study.

Literature Review

Concept of Supply Chain Management and Freight Optimization

Supply chain management concept is mainly to plan, organize and coordinate the systematic flow of materials and information from supplier to manufacturer for production purpose and also to distribute products to wholesalers, depots, warehouses and finally to get customers satisfied by getting the products at the right time, in the right quantity, at the right place. According to Adepoju and Mogbojuri (2021) in the course manual developed for Maritime Academy of Nigeria in Supply Chain Management, they emphasized that, supply chain should achieve the seven rights as



follows: (1) *right materials*, (2) *right place*, (3) *right price*, (4) *right source*, (5) *right quantity*, (6) *right time*, (7) *right service*. However, it is doubtful if all these rights are first, presents in all supply chain processes and secondly, that there will not be trade-offs among them in implementation. According to Ross (2002) supply chain management emanated from the concept of logistics and went through stages from departmentalization to decentralization to internal logistics and transportation, to full supply chain management and now to e-supply chain management. Johnson et al (2011) explained that Supply Chain management is very broad and involves procurement, warehousing, selection, negotiation, material handling, purchasing, distribution, packaging, transportation, inventory control, scheduling and reverse flow logistics. They explained the goals of supply chain management as follows:

1. The purpose of improving organization's competitive advantage. This is in relation to producing products or buying in large quantities to enjoy discount and sell below competitors' market price
2. Well planned supply chain management will forecast well so as to cater for possible disruption in flow of supply which can lead to stock out and loss of customers.
3. Supply chain management strikes a balance in money invested in inventory and other havocs that can happen to storing goods like damages, obsolescence and cost of rents.
4. Supply chain management attempts to maintain the quality of products
5. Supply Chain management strategizes how best suppliers can be sought for
6. Supply chain management synchronizes and programme how activities are to be executed to minimize waste.
7. Supply chain management harmonizes production and internal relationships

In an attempt to create a quality product and service, the introduction of Six Sigma concept was introduced in supply chain management. This concept is about cost reduction strategy and profit maximization with the idea that the standard deviation cannot be more than 3.4 per million of opportunities. This means that, variation between expected quality and actual quality cannot be more than 3.4 in standard deviation. It seeks to measure, analyze, control, and improve supply chain processes to achieve the objectives of cost reduction and profit maximization (Johnson et al (2011). Assessing supply chain management of freight transport in Nigeria requires an examination of each major mode used in carriage of goods. The following challenges have been observed across selected transport system in intermodal freight movement in Nigeria:

Transportation and Freight Challenges in Nigeria

Freight transport system in Nigeria has been ineffective arising from the cost of fuel, traffic congestion, bad road, multiple taxations, bad maintenance culture and lack or inadequate policy enforcement. According to Avanenge and Zizi (2016) the problem of transportation of freight movement in Africa stemmed from inadequacy of fleet vehicles, bad road, inadequacy of train, congested seaport and less effective air traffic. Furthermore, they expressed that, inadequate competent managers or fleet operators and ineffective transport regulations are bane of freight development in developing economies. Walters (2003) enumerated some of the challenges of freight movement as lack of adequate rest on the part of drivers especially during the peak periods,



multiple taxations that truck owners are subjected to and traffic challenges with pollution fines in urban centres. The operations in freight transport require intermodal or intra-modal transport system. This can be in form of carriage by trucks, ocean liners, container carriage, liquid tanker, barge operations all in an attempt to ensure that, goods are delivered at appropriate destinations. Freight transport is crucial for any economy because of its influence on commerce and distribution of wealth. Container freight was conceived in an attempt to consolidate goods, save cost and protect the environment. It was also observed that, warehouses or distribution centres are not many as required by haulage operators. In most cases, freight consolidation centres are created to ease distribution problems and challenges of frequency which will waste logistics cost and cause traffic issues (Lewis et al, 2010). In another perspective, Campbell et al (2010) provided that, the consolidation centres can be used for sorting, labeling, packaging, stock room and facilities for staff training. Freight movement of goods to distribution centres avail logistics firms opportunity to avoid traffic congestion and enables wholesalers and retailers to effectively distribute goods to the final consumers. In freight planning, there are factors to be considered for the purpose of its effectiveness. These include location of distribution centres closeness to market, stakeholders support, type of product, financial issues, infrastructure availability, taxation and policies. McKinnon and Ge (2004) reported that, freight transport must consider load factor. Load factor is important in the efficiency and utilization of vehicles for the movement of goods. For instance, 69% utilization of deck area of trucks was found to be obtainable in United Kingdom and average utilization of weight is 53%. When the Truck Load (TL) is not maximized, there are tendencies that, profit maximization of full truck load will not be realized. The recent challenges now in Nigeria are the insecurity on Nigerian roads. Challenges of kidnapping, terrorism and holding people for ransom forced people or movement of goods to day travel time (Business Day, 2022). Walubengo and Simwa (2022) enumerated the challenges of transportation in Nigeria with the first being the poor road infrastructure. The condition of road determines the volume to be carried, damages to the goods and cost of movement in supply chain. When roads are bad, the transport operators will increase the cost of transport and subsequently, the cost of whatever good that is carried. Inability to integrate train services effectively is one of the major problems of transport system in Nigeria. Each mode of transport has its unique characteristics but is to be properly utilized and integrated. The over laden on road transport used to cause the problem of accidents, low life span of roads, congestion and wear and tear of vehicles. Bad roads results in delay and possible damage to goods. Cargo delivery by air is mostly affected by delay arising from weather condition, technical problem with aircraft and delay related to connecting flight or documentation procedures (Ayantoyinbo and Adepoju, 2019). Lifting cargo by air within Nigeria is not pronounced. According to Shadare (2023), this is a segment of aviation that can generate up to N40 Billion Naira if well harnessed. He however, lamented the challenges ranging from cost of aircraft, multiple taxation, bribery and corruption, fewer demand, cargo theft, communication challenges and cargo security. It should be noted that, air transport is suitable for goods that require timely delivery and cannot carry heavy weight goods because of the constraints in maximum permitted weight. Ayantoyinbo (2018) emphasized the major variable cost that is inhibiting aviation logistics in Nigeria is the cost of aviation fuel. In air freight logistics, the cost is accumulated by handling, freight, forwarding, ramp handling and miscellaneous airport charges.



Rail transport is the most potent in the carriage of goods of all kind all over the world at cheapest rate. Avanenge and Zizi (2016) cited National Bureau of Statistics and Transport that, rail transport is most suitable for the carriage of heavy goods because of low cost per load as train load increases. The shared proportion of goods between rail and road can be said to be lost to road due to narrow gauge, lack of adequate patronage, low speed and ineffective services. The Nigerian Rail transport system from inception has relied on government subventions and hitherto yet to be self-sustained. Adepaju and Okolo (2019) explained that, the rail network in Nigeria as shown in Figure 1 was to convey goods from various geopolitical zones of the country for exploration and exportation by the Colonia masters. Nigeria is blessed with goods like solid minerals viz: bauxite, tin, coal; agricultural resources like: cocoa, colanut, cashew nut, cattle, onions, potatoes, shogun, millet, ginger, and vegetables. These are located in places like Enugu, Pleateau, Kano, Oyo, e.t.c apart from crude oil in Niger-Delta States of Bayelsa, Akwa Ibom, Rivers, Cross Rivers, Ondo, and Delta. Rail freight has relatively longer transit time than road transport but suitable for long distances. Majorly, countries used to have a body overseeing the activities of rail transport by owning and operating it. Lack of privatization of rail transport sector has made the sector not to be competitive in Nigeria. In United States of America, each train has its own track and can collaborate if need be. There are different operational guidelines for privatized rail system in different country on carriage of goods. Rail transport is considered to be the next best mode of moving goods in supply chain after shipping and follow by trucking before other means and modes of transport. Effective utilization of rail transport is about giving it proportion of its share in intermodal system by recognizing its strength and weaknesses.

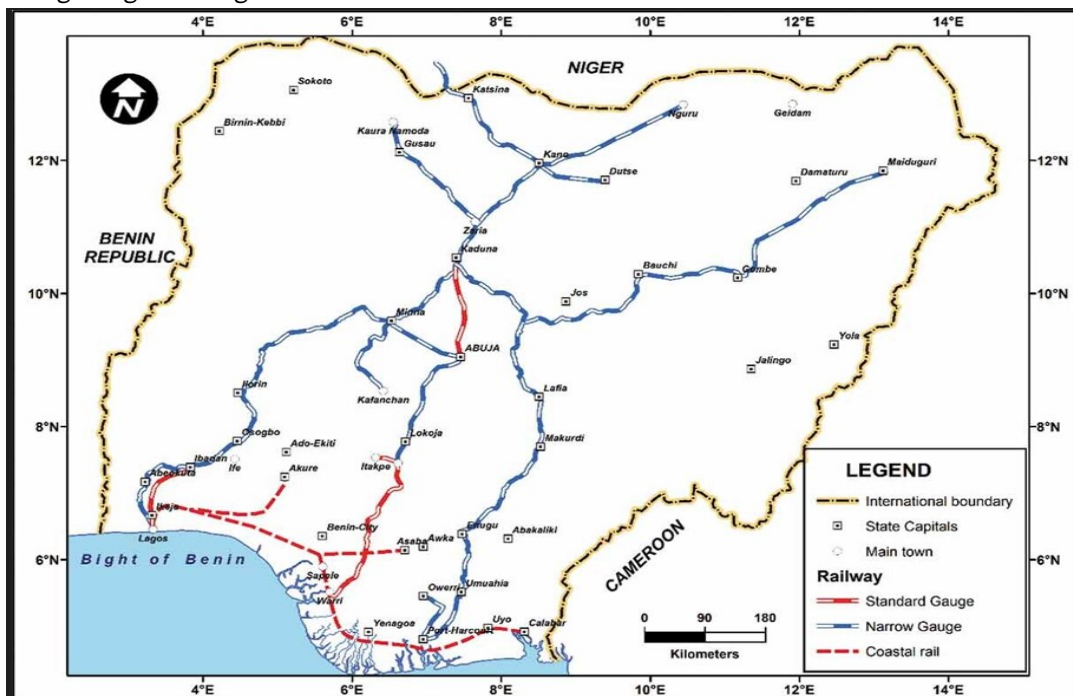


Figure 1: Nigerian Rail Network
Source: Adebukola (2022)



Water transport is critical for Nigeria as one of the nations privileged with abundance of crude oil natural resources. When cargo is carried by more than one mode, it is intermodal or co-modal. Over 96% of the transportation of Nigeria's external trade is by maritime transport (Eto, 2019). Challenges facing Nigeria's supply chain from congested seaports has its tone in surcharges at the port, inadequate involvement of Nigerians in cargo lifting, empty vessels on return voyage, inadequacy of ships to cater for ever increasing cargo demand, lack of seamless integrated system for payment and connectivity of seaports with rail transport functionality (Adepoju, 2020, Somuyiwa et al, 2021, Dosunmu and Adepoju, 2022). There is no adequate cargo handling equipment in most of the Nigerian seaports. Issues related to port rat (theft), damage to imported materials, missing of materials and delays in clearance of cargo are enumerated as challenges at Nigerian seaports by (The Guardian, 2023). Due to delays at most Nigerian seaports and surcharges; there are diversion of cargoes to neighboring countries for ease of timely delivery and cost reduction in supply chain. Adepoju et al (2023) explained problems of inland waterways with occurrence of incessant boat mishaps due to use of old craft, overladen, poor skillful man power and non-availability of spare parts that occasionally resulting to poor boat repairs. Chijioke et al (2022) further explained that, channeling water for irrigation, not taking safety precautions and use of obsolete boats are the challenges of inland water transport in south-eastern Nigeria. In the supply of goods especially in Lagos, inland waterways is yet to be fully optimized as many people are hydrophobia (fear water). This problem has not made people to utilize this means of transport even when they know it will be faster, cost effective and generate maximum turnaround time.

Apart from the aforementioned, the challenges of moving goods in general supply chain can also be inked with poor warehouse management. For many companies, they share warehouse and many companies do not have and as such goods can be returned by their trucks or forced on the wholesalers who may delay in payment as goods may not be sold as expected. Companies across Nigeria adopted Economic Quantity Order model. A model that is concerned with getting the right quantity produced and supplied to the customer so as to strike a balance between over production and under production (Lewis, 1995). While many companies have adopted the use of software to manage their warehouse system (Warehouse Management System) WMS and the use of other software like Manufacturing Resource Planning (MRP1 or 11) including Enterprise Resource Planning System (ERP), others are yet to do so for reasons related to cost, manpower handling, fear, and financial implications. Lovlyn (2016) proved that, companies with regional distribution centres benefit from the concept of Economic Order Quantity than others who do not have such opportunity. Warehouse management requires fumigation for some product, refrigeration for others, incurring of rentage cost, security and material handling. Sometimes, claims for loss, deterioration or damages accrue to supply chain management of goods stored in the warehouses. While warehouse management deals with storage, packing and picking; inventory deals with stock management, forecast and stock allocation or reception.

According to Conover (2001) transport management system can be integrated to take care of almost all the activities in supply freight movement. Figure 2 presented adopted features of parameters included in the Transport Management System (TSM).

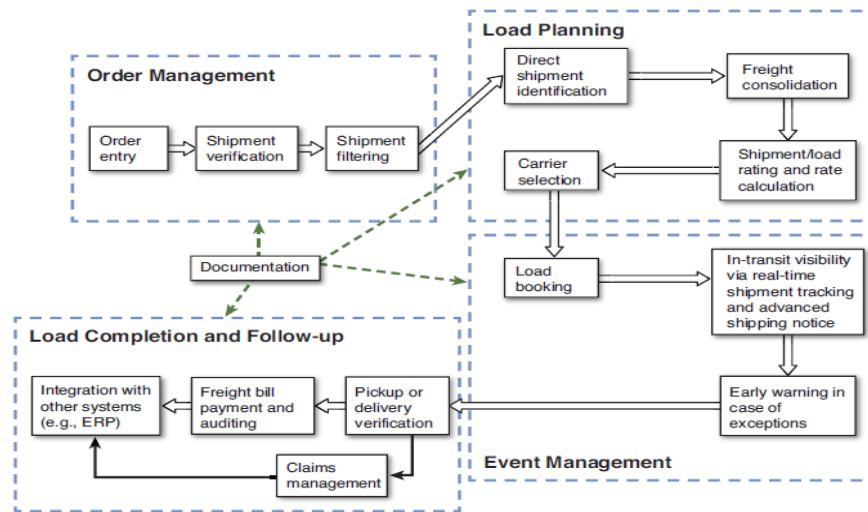


Figure 2: Transport Management System

Source: Adopted from Conover (2011)

Conover (2001) explained that, following this model will guarantee cost reduction in transportation by 5-30%, customer satisfaction, timely scheduling, tracking and automation.

Theory of logistics Constraint

Theory of constraint aimed at eliminating or reducing all impediments against logistics or supply chain activities. Adopting this theory is for the purpose of removing all constraints in the freight movement especially of companies' products from production sites to depots or warehouses (physical distribution). According to Aguilar-Escobar et al (2016) who noted that theory of constraint (TOC) was initiated with optimization to production or operation management concept with the aim of improving quality and eliminating waste. Watson et al (2007) explained the concept further by explaining that Goldratt's book titled "it is not luck" was designed to identify the bottle necks with the use of five focusing steps. The first step is to critically identify the constraint in the supply chain system. For example, this can be incessant delay arising from late delivery of goods which can cause customers to buy alternative products, pave way for loss in revenue for company and increase fuel and cost of delivery. Constraint may be political, financial, and as a result of government policy. Whatever it is, it must first be identified. The second step is to determine to eliminate the constraint. Though, it may be impossible to out rightly eliminate all constraints as this may be beyond the companies' capability. For example, it is not practically possible to eliminate congestion along a particular route but time of movement can be programmed to avoid the congestion. Similarly, if frequency of movement increased transportation cost, warehouse may be the solution. However, cost of keeping and maintaining warehouse for security, rentage and preservation must not be more than the cost of transporting items in bits without cost of storage. Therefore, eliminating constraint may be difficult but breaking even and striking a balance to minimize error and cost is the aim of effective supply chain management operations. After this second step is the synchronization of step 1 and 2. In this case, test running of the elimination may be executed with fewer or lesser operation and observe its performance before applying on whole

supply chain management process. The constraint may further be exposed to be political or other external previously unknown factor which is now known through the test run. Step four involves a situation for application and this may call for adjustment or more investment for the goal of removing bottleneck in supply chain management to be achieved. The last step is the fifth one where the exercise may have to be repeated to probably discover the imbalance in the system or readjustment for desired goals to be achieved. While concept of Total Quality Management (TQM), lean logistics, Just-in-time logistics have been used to further eliminate bottlenecks in supply chain management, today's supply chain management has been influenced with latest technology in form of block chain, e-commerce and e-logistics. Though, physical items must be transported from one location to another, information technology has removed unnecessary logistics with the help of communication and has also facilitated freight movement through same communication system. Somuyiwa and Adepoju (2018) expressed that, constraint in selling products was initially to improve marketing skills through place, price, promotion and place. However, three 3Ps (People, Process and Product) have been used to further improve supply chain management process like educating the people, improving the process and physical aspect of the product. Min (2015) illustrated theory of constraint with the Figure 3 below. He maintained that, the weakest link in the supply chain should always be observed and monitor. Using an example of a supplier whose raw material will be used to produce a product. If there is delay in getting the raw material, there will be delay in order fulfillment and customer satisfaction because of weakness from the supply. According to him, at every point in time, the interface between logistics and marketing should be observed in the chain linking all processes involved in supply chain in order to keep the chain in motion.

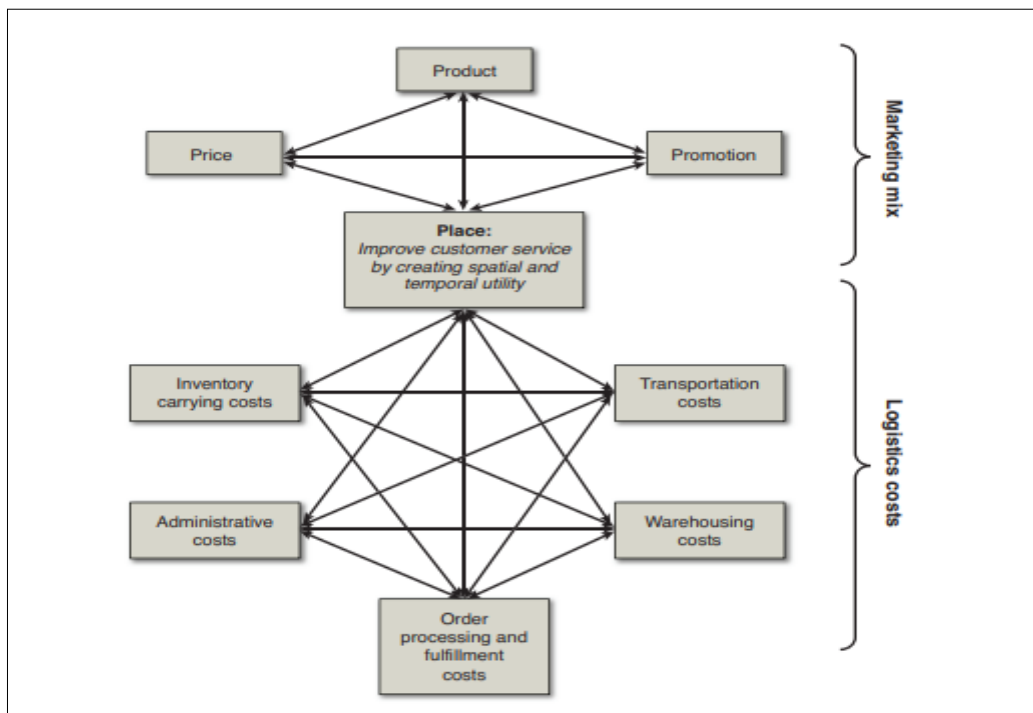


Figure 3: Interface in Logistics and Marketing



Nowakowska-Grunt and Moroz (2013) used the thinking process of Theory of Constraint (TOC) as applicable to supply chain management process. They opined that, if there are five ships berthing at the same time and there are five dockworkers to unload the ship. The traditional method will be to assign a person to a ship so as to offload this ship say in the next five days. Using theory of constraint thinking process will make use of all the five dockworkers per day on the first ship and second day on the second ship and so on to the last ship. It was observed that, this way the job will be faster, easier and less demanding. The theory suggested that there is cause and effect relationship in supply chain which can be identified in the area of conflict or conflicting objectives. Furthermore, that contradictions in supply chain can be resolved once identified and lastly, because there can be no restriction to improvement, if the people are shown what will benefit them. Looking at constraints in freight movement in Nigeria, majorly each mode of transport has one problem or another; the roads are terribly bad which usually lead to damages to goods, high cost of transport and delay in delivery. The use of heavy trucks on roads that are not of standard quality overburdened this mode of transportation. The rail transport is monopolized and tracks are usually vandalized while services are not effective with attacks from bandits and terrorist. Maritime transport is not optimized to the advantage of local investors; regulation of inland waterways has not achieved its desired result and people do not have confidence in moving their goods through the means of transport. Air transport has not been generating enough traffic because of level of economic situation and inflation in the country. Focus of air transport on passenger is higher and opportunities in freight movement have not been optimized. Generally, Nigerian transport and freight movement require a stringent policy initiative that will propel economic growth and development.

Methodology

Nigeria is a country in Western Africa. It has estimated population over 200 million people. Lagos is described as the center of excellence in Nigeria. Four transportation companies out of seven with Plc status are: MPZ Haulge, Muahlb Ltd, STL Logitics, and Ajah Logistics were selected because they have depots at each geopolitical zone in Nigeria. The composition of supply chain managers and warehouse supervisors and logistics manager were the targeted respondents. Of the 307 respondents of this targeted population, 275 (89.6%) responses were retrieved from systematic random sampling technique for the selected companies. Research instrument was designed through Google forms and collected data has been analyzed with One sample T-test. Secondly, areas to be strengthened were analyzed with descriptive bar chart.

Result and Discussion

The research postulated that a null hypothesis that (H_0) “*there are no significant differences in challenges facing freight logistics companies in Nigeria*” Arising from this postulation, the data collected from the designed Google form has been summarized in Table 1. This section produced the result from T-test analysis. The data summary for identified challenges from the questionnaire is based on Table 1.

Table 1: Challenges of Freight movement in supply chain management in Nigeria

	Challenges	MPZ	Muahlb Ltd	STL	Ajah	
1	Bad road (BRD)	19	22	19	22	
2	Bad Drivers (BDR)	12	10	15	14	
3	Information system/tracking (IFT)	12	14	18	19	
4	Warehouse/(DRC)	12	21	12	18	



5	Fuel cost/ (OPC)	25	16	22	23	
Total		55	83	64	73	275

Source: Authors' compilation (2023)

Table 1 data has been used for One sample T-test for the challenges faced by the movement of freight in supply chain management in Nigeria. The resultant result from the analysis is presented in Table 2.

Table 2: One sample T-test of Challenges in freight movement of supply chain in Nigeria

One-Sample Test

Test Value = 0						
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
BRD	23.671	3	.000	20.50000	17.7439	23.2561
BDR	11.500	3	.001	12.75000	9.2217	16.2783
IFT	9.534	3	.002	15.75000	10.4925	21.0075
DRC	7.000	3	.006	15.75000	8.5895	22.9105
OPC	11.103	3	.002	21.50000	15.3372	27.6628

Table 2 shows the result of the analysis from the data collected from the selected companies in the course of distributing their goods across to customers in Nigeria. Looking at all the sig. (2 tailed) values, it can be observed that all identified factors or variables are significant. Hence alternate hypothesis can be confirmed. i.e H_1 : *there are significant differences in challenges facing freight logistics companies in Nigeria*” Secondly, the highest problem confronting supply chain distribution through freight movement can be seen to be the bad roads with t value of 23.671. Next to it is the bad driver with t-value of 11.500 and followed by operating cost like fuel cost with 11.103 value. Most companies face challenges of information system and tracking of goods as this came fourth in among the challenges and lastly the problem of warehouse or distribution centres.

From the analysis, it can be observed that the major problem in the supply chain for companies in freight logistics is the bad roads. The problem is more of close to 40% when combined among all problems of supply chain logistics in Nigeria. However, drivers are also problems in the distribution of goods. Not even operating cost that came second but operating personnel. Operating cost like the cost of fuel and others constituted challenges of the supply chain logistics in freight transport industry. Most of the companies are less bothered with distribution centres probably they have wholesalers across the states and most of them do not consider the issue of tracking or monitoring with information system as such important issue though very significant in the analysis.

The second question raised was concerning turnaround time and factors influencing the delay in logistics and movement of vehicles in supply chain. Figure 1 shows identified factors for respondents to tick and the generated responses for each identified factor.

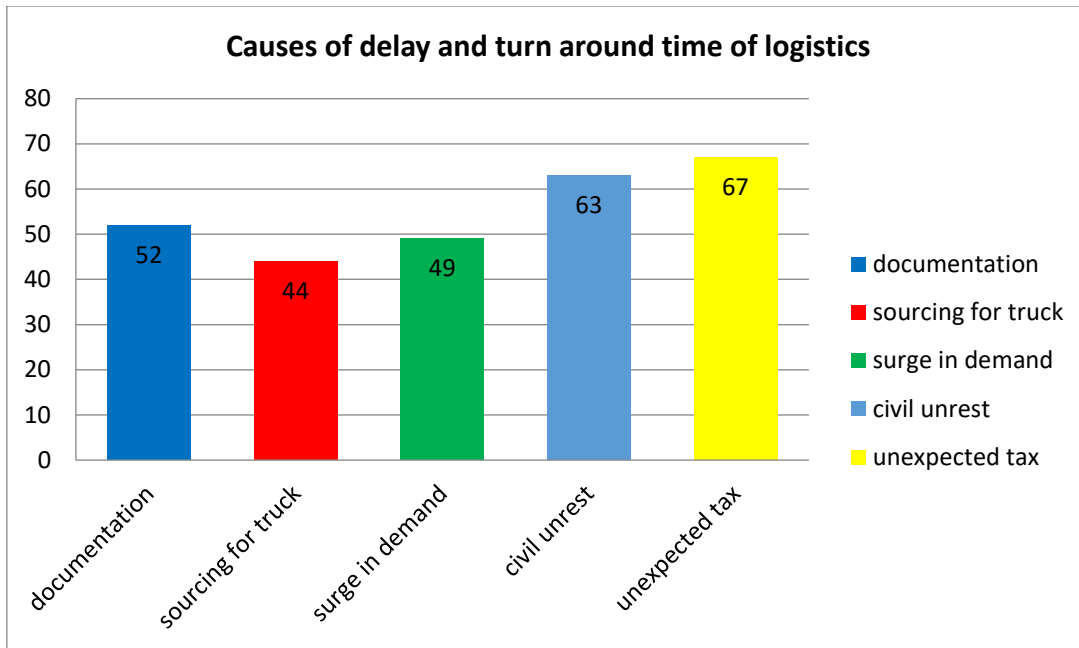


Figure 1: **Causes of delay and turn around time of logistics**

Unexpected tax along major highway in Nigeria has been described as the highest cause of delay in supply chain management as it constitutes 24% of what delays delivery of goods at the right time in Nigeria. Civil unrest is the second delay causative factor for delivery especially when driver has no alternative route to follow and its contribution is 22%. Documentation, surge in demand and sourcing for trucks are respectively contributing about 18%, 17% and 16% to delay and turnaround time in the supply chain of goods in Nigeria.

Conclusion and recommendations

This paper has been able to identify the challenges and causes of delay in freight movement and supply chain management in Nigeria. The most challenging issue in freight is the issue of bad road in Nigeria. Of note is also the drivers using the vehicles in which case has been observed to be the second challenge and the operating cost. Though, most organizations do not care much about installation of tracking and information system device and setting up warehouses or distribution centres, they are of importance in the supply chain system. Delay of truck or vehicle delivery at the right time occasioned by unexpected tax on the road across the states in Nigeria is a serious problem. There seem to be no possible solution insight for civil unrest which also causes delay but surge in demand, sourcing for truck and documentation can be improved through information systems. This research therefore recommends that:

1. Government should endeavor to seek for ways by which Nigerian roads can be financed, repaired and maintained
2. Each company should endeavour to train their drivers on ethics of driving, defensive driving and how to take good care of vehicle as an asset
3. Companies are encourages to install monitoring and information system gadgets into their vehicles if they can afford it
4. It is important to have distribution centres as it enhances product availability
5. Government should harmonized all the taxes to be paid by transport companies and make them aware for a minimum of six month



6. Sourcing for trucks, documentation and surge in demand can be solved by creating applications that will link companies together to allow for sourcing during peak period and also synchronization of documentation processes through software applications.

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