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THE EFFECT OF ROAD TRAFFIC DELAY ON SUPPLY CHAIN PERFORMANCE OF MANUFACTURING FIRMS IN LAGOS STATE, NIGERIA

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ABSTRACT: *This study examined the trend of traffic growth and its resultant effect on supply chain performance on manufacturing firms in Lagos State, Nigeria. The study adopted purposive and simple random sampling technique. Firms along transport congestion corridors were purposively selected. and workers in the selected firms were randomly selected. Sampled firms distributors and customers were also used to gather information regarding supply chain performance. A total number of 225 respondents were randomly sampled from 3,981 workers of two firms to solicit information on how congestion affects supply chain performance, analysis was done using multiple regression analyze. Result shows that all identified variable were statistically significant except goods returned and fuel consumption at p<0.005. From the findings, the study concluded that there is inverse relationship between traffic congestion and supply chain performance. This implied that as traffic congestion increases it have a resultant effect on supply chain performance. Therefore, the study recommended that government and other stakeholders should see congestion as a collective task in order to improve free flow of traffic that would significantly improve supply chain performance both in local and national economy.*

KEYWORDS: Transport, Congestion, Delay, Supply chain, Logistics, Order Fulfilment.

INTRODUCTION

Transportation system is an integral part of a modern day society, designed to provide efficient and economical movement between the component parts of a country and offer maximum possible mobility to all citizens (Leshem and Ritov, 2007). Transport is so central to all economic activity – in moving raw materials to factories, labor to worksites, inputs and outputs along supply chains, consumers to services, and products to consumers (Andrew, Taner, Brian and Trevor 2015). Road transport is a catalyst of urban, rural and national development. It is a catalyst by facilitating the movements associated with urban and national development and providing the means by which goods and services are made available to industry and consumers, creating opportunities for social and economic interaction and employment. Without transport, access to these facilities would not be possible and the services they provide not consumable. Transport is what gives life to development (Gunnarson, 1998; Speathing 1999; Oni, 2001; Atubi, 2006). In the past few decades, African cities have been experiencing huge population increases. This is mainly due to fastest urbanization and rural exodus (International Association of Public Transport and African Association of Public Transport 2010). Such fast-growing cities face enormous challenges in terms of infrastructure provision and the need to cope with the increasing demand for transport. This is especially shortened as much of the existing road infrastructure in African cities is far from being appropriate for the actual transport demand.

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Congestion is relatively easy to recognize when roads are noticeably filled with cars, trucks, buses and sidewalks filled with pedestrians. Congestion, both in perception and reality impacts the movement of people and freight in most urban areas and is deeply tied to our history of high level of accessibility and mobility (Downs, 2004). Andrew *et al* (2015) defined congestion as a process that slows the flow of people and goods, making trips take longer and arrival times more uncertain. Time spent in traffic is often time that could otherwise be spent doing something productive for drivers, passengers, and even goods.

Indeed, traffic congestion is widely viewed as a growing problem in many urban areas across the world and in particular mega cities like Lagos; because the overall volume of vehicular traffic in many areas (as reflected by aggregate measures of vehicle-kilometres of travel) continues to grow faster than the overall capacity of the transportation system. The resulting traffic slowdowns can have a wide range of negative effects on people and on the business economy, including impacts on air quality due to additional vehicle emissions, quality of life due to personal time delays, and business activity due to the additional costs and reduced service areas for workforce, supplier, and customer markets (Ministry of Economic Planning and Budgeting, 2013). Congestion remains the main impediments for all activities whose attainment depends on transport being public, government or individual. The resultant effect in general are losses and in special way in all aspects pertaining to social and economic sector. Congestion in Lagos is changing from bad to worse; more importantly worsened the economy of the State. This is due to poor urban planning implementation and obsolete cities policies. Therefore, the broad impacts of delays on local supply chains of manufacturing firms have not been adequately researched in transport and logistics literature in Nigeria. Despite recent efforts to upgrade transport infrastructure, both by Federal and state government, Lagos transport infrastructure is still inadequate to satisfy the huge demand generated by its booming economy. It has been predicted that, in the absence of any major transport policy initiatives, the level of congestion will rise by 40% above the 1990 level by 2007, 120% above it by 2017 and the total volume of traffic will grow by 28% by 2011 and 60% by 2031(Department of Environment, Transport and the Regions 1997; Alan, 1998).

In the economic context, as traffic volumes and congestion grows on highways and urban roadways, freight and delivery service operators become increasingly challenged to maintain dependable and reliable schedules. This affects supply chains and truck-dependent businesses both of which are of increasing importance for both public policy and private sector operators. There are day-to-day cost implications of delay and reliability as it affects supply chain management, and well as a longer-range need to assess opportunities, risks and returns associated with location, production and distribution decisions. Both perspectives need to be recognized when considering the full range of impacts that traffic congestion can have on the economy (Glen and Stephen 2011). This posit that the generalized growth of traffic congestion adds to total transport costs for delivered products, causing firms to shift location and shipment size configurations to re-optimize net revenues. Meller (2015) defined supply chain management as a broad range of activities require to plan, control and execute a product's flow from acquiring raw materials and production through distribution to the final customer in the most streamlined and cost effective way. This involves demand planning, sourcing, production, inventory management, storage and logistics. While there is also a separate line of research on bottlenecks at firms, the impacts of congestion can span different supply chain configurations – including not only the movement of material and parts to producers and then to distributors, but also local distribution and delivery of finished goods to retail markets, and even local delivery of parts and repair services to businesses and households. Since the movement of

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goods is done by supply chain management of the firms, it is reasonable premises that supply chain management command the profit of the firms. This implies that supply chain management is the heart of the manufacturing firms while logistics remains the flowing blood. Therefore, supply chain management is the groundwork that supports every manufacturing firm. Nowadays companies have to deal with a business environment that puts more accents on the concept of customer-driven manufacturing. This creates an environment where there is more emphasis on differentiated product features, tight delivery performances and low costs (Hicks, Earl, Mc Govern, 2000). As of the customer-driven emphasis it is important for the manufacturing firm to consistently produce high quality products with competitive unit costs and high service levels (i.e. on time deliveries) (Ebadian, Rabbani, Torabi and Jolai, 2009). Revelle (2001) confirms this by stating that the three major features of the make-to-order (MTO) process are quality, cost and delivery. Delivery time is the fundamental order-winning criterion. Supply chain management has received substantial attention from both researchers and practitioners, yet in many companies management is struggling to implement supply chain processes within their firms as well as across the supply chain. Order fulfillment is a key process in managing the supply chain. It is the customers' orders that put the supply chain in motion, and filling them efficiently and effectively is the first step in providing customer service. However, the order fulfillment process involves more than just filling orders. It is about designing a network and a process that permits a firm to meet customer requests while minimizing the total delivered cost (Keely, 2003). Hindrance to effective movement of goods and service in Lagos to meet consumers need and order fulfillment at appropriate time by the logistics of supply chain management is road traffic congestion, which the World Bank (1999) stated that it constitutes about 54.5% of all noticeable urban transport externalities. This study observed the trend of traffic growth with a view to examine its effects on delivery of goods, passengers and other services along supply chain performance across selected manufacturing firms in Lagos State, Nigeria.

LITERATURE/THEORETICAL UNDERPINNING

Transport and business cost of congestion

Traffic congestion has been defined as "a condition of traffic delay (i.e., when traffic flow is slowed below reasonable speeds) because the number of vehicles trying to use a road exceeds the design capacity of the traffic network to handle it." (Weisbrod, Vary and Treyz 2001). Most transportation literature and transportation impact models treat congestion as a cost factor, comprised of time delay and operating expense (Cambridge Systematics, 2008; Short, Trego & White 2010). However, a premium is often added in recognition of the variability aspect of congestion delay that is masked by focusing just on average delay statistics. Indeed, there is also a growing base of research on freight logistics and time-sensitive delivery which attempts to estimate the magnitude of cost premium associated with travel time reliability and the avoidance of delay for this class of travel (Rao & Grenoble, 1991; Small, Chu & Noland 1997; Cohen & Southworth, 1999; Grant-Muller & Laird, 2006). Another line of transportation research has highlighted the business productivity impact of growing traffic congestion. A US study laid out a framework for defining congestion and then viewing the ways in which it can affect regional economic competitiveness and growth by nullifying some of the agglomeration benefits (returns to scale) associated with operating a business in larger urban markets (Weisbrod *et al*, 2001, 2003). More recent work in the UK has shown how urban road traffic congestion, by constraining the benefits of agglomeration, can serve to reduce achievable levels

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of productivity in congested urban areas (Graham, 2007). However, all of these studies focused at a general level when discussing productivity and accessibility, and none of them investigated the "micro-level" mechanisms by which businesses actually see their productivity eroded by traffic congestion. Increased congestion can require various adaptations for businesses. Although adaptations are made, they are not costless. Contributions to the literature on the business costs of congestion point to several components of these costs, including (Weisbrod *et al*. 2001).

Congestion interrupts the advantages that businesses obtain in urban centres from the 'agglomeration' of buyers and suppliers of goods and services (Ciccone and Hall 1996). The commercial response to excess congestion in the centre of a city for some businesses is to relocate to the periphery. Those businesses reduce their costs, but they also break down networks of businesses that provided benefits to all of the participants in the network. Businesses will respond to congestion by adjusting their operations to minimise production costs. Businesses might adjust to congestion by moving away, or through adjusting their inventory management. In more severe cases, businesses might be unable to adjust and would go out of business. A recent survey of businesses in Portland in the US prepared by David (2007), highlighted a number of impacts of congestion on business production costs. These include: costs of additional drivers and trucks due to longer travel times; costly 'rescue drivers' to avoid missed deliveries due to unexpected delays; loss of productivity due to missed deliveries; shift changes to allow earlier production cut off; increased inventories; and reduced market accessibility and scale, including loss of market-scale and reduced access to specialised labour and materials. The NCHRP report boils down a wide range of issues to three types of direct cost categories from traffic congestion for business: direct travel costs of all business-related travel, including vehicle operating expenses and the value of time for drivers (and passengers); logistics and scheduling costs, including effects on inventory costs such as stocking, perishability and just-in-time (JIT) processing; and reduction in market areas for workers, customers and incoming/outgoing deliveries. Stank and Goldsby (2000) note that JIT production techniques have led to demand for faster, more frequent and more reliable supply of inputs. Extra transport costs are preferred to carrying inventory (Sankaran, Gore and Coldwell 2005). A paper by Shirley and Winston (2004a) examined how highway infrastructure investment, which essentially decreases congestion costs, generate benefits by lowering firms' inventories. Shirley and Winston (2004b) also examine the cost of highway congestion on firms' inventories. They estimate the highway cost of congestion on inventory and logistic costs is US$7 billion, with the costs of congestion to shippers accounting for nearly 25 per cent of total motorists and shippers congestion costs.

Most of the existing research literature on economic costs of urban traffic congestion is at a very broad-brush level, demonstrating that increased congestion can affect business productivity by increasing operating costs and reducing the size of market areas served from any given business location. However, there is little information beyond that level to explain the ways in which congestion affects different types of freight movement, different types of businesses, or the ways in which businesses can respond to those conditions. These issues and their economic consequences can only be addressed through more detailed micro-level analysis of business processes and business decision-making (Glen and Stephen, 2011).

Supply chain literature

A separate line of research studies on supply chain behavior have used systems dynamics models to show how traffic congestion can change the optimal decisions of producers,

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distributors and retailers along a supply chain. The most basic impact is that congestion delay and uncertainty increases requirements for (and hence costs of) product inventory (Disney, Naim and Towill 1997; Mason-Jones, Namim, & Towill 1997). That, in turn, can affect supply chain behavior by encouraging shipment of smaller lot sizes to reduce cost risk (Moinzadeh, Klastorin, & Emre., 1997). More recent research has extended this beyond delivery lot size, to also affect delivery frequency, spread of deliveries over time of day, and also total trips made per day (Sankaran & Wood, 2007). Surveys of corporate managers confirm that there is a range of ways in which traffic congestion can affect delivery decisions for retail (Fernie, Pfab, & Regan, 2000) and trucking industries (Golob & Regan, 2003). Simulation modeling has also been used to show how traffic congestion can lead to fluctuations along a supply chain, as retailers adjust their inventory which in turn "reverberates upstream" via a "bullwhip" effect on inventory requirements for distributors and suppliers (Lee, Padmanabhan & Whang, 1997). However, since significant congestion delays may occur on a non-predictable basis, the optimal responses of affected parties may critically depend on both where they are in the supply chain and the probability of occurrence (Wilson, 2008). In the longer run, firms may also change their location decisions to minimize congestion impacts (Geunes & Konur, 2009). Yet most of these studies are based on simulations, and there has been relatively little attention to the question of how business decisions regarding location, scheduling, and deployment of vehicles and labor resources can also contribute to congestion or be used to minimize the effects of rising traffic congestion.

Supply chain management has received substantial attention from both researchers and practitioners, yet in many companies management is struggling to implement supply chain processes within their firms as well as across the supply chain. Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders (Lambert, Douglas, Martha and Janus 1998). The order fulfillment process needs to be designed around the customer, but within the limits of the firm's business and marketing strategy. At the operational level, order fulfillment is very transactional. It is focused on managing the customer order cycle and the specific activities are executed primarily within the logistics function. In fact, a customer order is said to serve "as the communications message that sets the logistics process in motion" (Stock and Douglas 2001). Order fulfilment cycle (OFC) comprises the process in receiving, processing and delivering a customer order. It refers to all the steps companies must take from the moment they receive an order until the goods land in customers' hands. There are many types of order fulfilment options such as Engineer-to-Order where the product is completely build and designed to customer specifications, or Assemble-to-Order where the product is built to customer specifications from an inventory of existing materials, and finally to Make-to-Stock (MTS) where the product is built against a sales forecast, and sold to the customer from an inventory of finished goods (Orrigo, 2015). Production must be aware what needs to be produced and when, and distribution needs to know when the goods must be transported from the production to the warehouse or distribution centre. When there is lack of communication within the supply chain, the replenishing of stock is likely to fail. Production can produce products in wrong order or distribution could transport wrong goods. This again will cause out of stock situations and the customers' orders cannot be fully fulfilled in time (Meller, 2015). If the company is able to provide order fulfilment cycle in a way that satisfies the customer, it will create value for the customer. When a satisfactory OFC is combined with good product(s) and/or service(s), company's market position will be strong. Fast fulfilment will help the company to retain their current customers, and even open doors for new customers who are speed sensitive. Faster

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order processing and later order cut-off times also gives more time for the company to transport the goods. By using more time on transportation, company will be able to realise even larger geographic reach (Muzumdar and Zinzuwadia, 2015).

When company is able to process the orders quickly, they do not need to keep high levels of inventory as a safety stock. Goods needed for the order will stay shorter time in their distribution centre since the order processing requires less time. This again will reduce the total inventory and create significant savings within the supply chain. Company is able to utilise the space better as there is no need to store the goods in shelves like before. This free space can be used for other needs or even totally new products. (Meller, 2015). There are many different processes within the supply chain such as manufacturing, warehousing, transportation, planning e.t.c which can be optimized organization of all sizes and across all industries can achieve significant by making their supply chain cost efficient (O'Byrne, 2011). For the organisation to be able to gain the best possible knowledge and really utilise business intelligence for its benefits, it needs to pay attention and analyse each the logistics part of the firms supply chain in the study area, there is need to study the nature of congestion in Lagos state and possible way to meet consumers demand.

METHODOLOGY

The study was carried out in Lagos State, a mega city in the South Western part of Nigeria. Lagos state is situated within Latitude 6 degrees and 23'N and Longitude 2 degrees and 3 degrees 42'E. The choice of Lagos state was borne out of the fact that it is the second largest populated city in Nigeria (National Population Census, 2006) and also it is popularly referred to as the hub of economic activities in Nigeria (Fadare and Ayantoyinbo, 2010).

The researchers conducted a survey between the months of June to December 2017, this is the months where Logistics activities is at the pick, hence, the data used in the research work. Data were obtained with the aid of structured questionnaires. Two (2) commercial locations namely Apapa and Oshodi/Ikeja were purposively sampled because of their link to the principal traffic congestion corridors of Apapa-Oshodi express way and Agege motor road. However, the two manufacturing firms that were of concern in this research work were Delis biscuit, Oshodi and SevenUp bottling company, Ijora purposively selected because they fall within the chosen congested area and they operate a large supply chain department. Data were collected from only primary source and respondents selected through simple random sampling technique. The main instruments used in collecting data was the questionnaire and data analyzed based on 82% response rate. The 225 respondents which include 100 logistics workers in the selected firms, 60 distributors and 78 customers. Information were solicited in respect of effect of congestion on their operations as regards Supply Chain performance. Data collected were analyzed using multiple regression. Hence, the equation for the regression expressed as;

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + ...\beta_n X_n + e.$$

Y = Supply chain Performance

a = Constant.

$\beta_1 \ldots \beta_n$ = parameters to be estimated (i = 1, 2, 3 … n)

X_1 = Loss of firms' reputation

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X_2 = Productivity

X_3 = Delay delivery

X_4 = Returns of Goods

X_5 = Loss of revenue

X_6 = Customer order

X_7 = Wholesalers/Retailers relationship

X_8 = Lead time

X_9 = Market Coverage

X_{10} = Safety

X_{11} = Fuel consumption

X_{12} = Operational costs

RESULTS/FINDINGS

From Table 4.1 multiple R of 0.751 shows that there is correlation between the dependent variable Supply Chain Performance and the independent variables Loss of firms reputation, Productivity, Delay delivery, Loss revenue, Customers order, wholesaler/retailer relationship, Lead time, Market coverage, Safety and Operational costs, this yield a coefficient of multiple regression R^2 of 0.565 accounting for approximately 57% of the variance in Supply Chain Performance of manufacturing firms in Lagos State. The p-value of (0.000) confirm that the model is a good fit for the data and this indicates that there is relationship between the dependent variable and the set of independent variables

Table 4.1: Result and Discussion

Multiple R	.751
R Square (R^2)	.565
Adjusted R.Square	.540
Standard Error	.339

Analysis of Variance Table

	DF	Sum of Squares	Mean Square	F-ratio
Regression	12	31.777	2.648	23.017
Residual	213	24.506	.113	

Source: Data Analysis (2018)

Table 4.2 indicates that only two variables are not statistically significant, these are returned goods and fuel consumption, with significant value of 0.431 and 0,882 respectively. On the other hand the table shows that a unit increase in loss of firm's reputation causes a decrease in the performance of the supply chain of the manufacturing firms by 0.148, the implication is that as the traffic delay causes disappointment to the customers the company continue to loo

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its reputation. Equally, the table reveals that manufacturing firms are more productive when they can nib the cause of road traffic delay within the firm, a aunit increase in firms productivity will lead to an increase in the supply chain performance by 0.130. Delay in delivery with coefficient value of 0.076 will lead to a decrease in supply chain performance. This implies that for a smooth supply chain activities manufacturing firms should focus on effective delivery throughout the supply chain system. Consequently delay in delivery will also lead to loss of revenue with value of 0.078, increased lead time with 0.177 coefficient value and a unit increase in operational cost with 0.176. It can be further estimated that manufacturing firms must pay special attention to delivery method to reduce their lead time, increase their revenue and reduce their operational cost.

Table 4.2: Analysis of Identified Variables

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.924	.185		4.991	.000
	X_1	-.148	.042	-.185	-3.475	.001
	X_2	.130	.024	.350	5.503	.000
	X_3	-.076	.024	-.206	-3.149	.002
	X_4	-.024	.030	-.044	-.790	.431
	X_5	-.078	.033	-.128	-2.323	.021
	X_6	.095	.027	.187	3.561	.000
	X_7	.258	.052	.271	4.922	.000
	X_8	-.177	.029	-.409	-6.017	.000
	X_9	.182	.038	.374	4.792	.000
	X_{10}	.194	.024	.425	8.077	.000
	X_{11}	.007	.050	.010	.148	.882
	X_{12}	-.176	.060	-.155	-2.935	.004

Source: Data Analysis (2018)

In addition, a unit increase in customer orders will lead to increase in the supply chain performance by 0.095, a unit increase in market coverage will also lead to increase in supply chain performance by 0.182. Safety is essential in the operation of supply chain system, therefore a unit increase in safety will cause an increase in the performance of supply chain in manufacturing firm. Road traffic delay on supply chain performance of manufacturing firm can be eliminated when there is a positive relationship between the wholesalers/retailer and the firm which can be seen from the table 4.2; that a unit increase in the wholesaler/retailer relationship will lead to increase in the supply chain performance of manufacturing firm

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CONCLUSION AND RECOMMENDATION

The study evaluated the trend of traffic growth and its resultant effect on supply chain performance on manufacturing firms in Lagos State, Nigeria. Moreover, it was concluded that the firms' reputation has been jeopardized due to their inability to meet orders required time to customers, once the order cannot be fulfilled at appropriate time, two things were likely to happen; customer are likely to cancel order or the firm will forcefully place a discount to that particular order. It was further concluded that there is poor relationship between wholesalers and retailers due to congestion and this has effect on the whole firms. The implication is that distributors and customers will shift from the firm to a competitors firm and this have a direct effect on the profit of the firm.

Efforts at reducing congestion by expanding road intersection, providing adequate infrastructures, improving road condition, using alternative modes, upgrading public transport, implementing road policies and embracing ride sharing in order to reduce traffic congestion and consequently reduce poor order fulfillment by the firms logistics are required. Since traffic congestion is found to negate order fulfillment of the firms to customers, and to ease congestion in the study area, government and other stakeholders should see congestion as a collective task in reducing traffic congestion on the roads in order to improve free flow of traffic that would significantly improve logistics order fulfillment in both the local and national economy.

Easing the effects of road traffic congestion on firms supply chain

There are numerous ways in which firms can reduce the vulnerability of their Supply chain operations to traffic congestion:

Scheduling vehicle movements to avoid peak times

According to Browne and Allen [1997], 'more night / outside peak hours operations and deliveries' was deemed the most popular option for dealing with congestion. As traffic congestion mounts, the need grows for a fundamental re-examination of the scheduling of deliveries across the supply chain.

Exploiting information technology

A study by (Mckinnon 1997), commissioned by the Royal Automobile Club (RAC), outlined a range of IT developments which could help firms manage the movement of freight more effectively on congested road networks. These include in-cab data communication, vehicle tracking, advance warning systems and dynamic routing using real-time data on traffic conditions. Furthermore, improved communication between vehicle and collection / delivery points can give logistics managers more time to plan for late arrivals. If used effectively this advance information can minimise the degree of disruption and any associated costs.

Overhauling goods reception operations

The basic function of the receiving and inspection process is to take responsibility for the inbound material, validate the material received to the purchase order (PO), check for any damage to the materials received and complete any required material inspections. Getting it right when you receive material will reduce headaches in downstream processes.

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Suggestions for further study

This study focused on the effect of road traffic delay on supply chain performance of manufacturing firms. Future studies should look into how traffic congestion affect small scale businesses

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