

LAST MILE LOGISTICS AND ON-TIME DELIVERY OF FRESH FRUIT AND VEGETABLES IN DELTA STATE AND RIVERS STATE, NIGERIA

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ABSTRACT

This study examined the relationship between last mile logistics and on time delivery of fresh fruits and vegetables in Delta State and Rivers State. Primary data were sought through questionnaire from 200 respondents in selected firms in the business of fresh fruit and vegetable delivery in Delta State and Rivers State. Cross sectional survey research design was adopted; probability sampling was used in the administration of questionnaire to respondents. The descriptive statistics, linear regression and correlation analysis were the methods used for analysis of data. The study used stata version 13 as the statistical tool to test the hypotheses formulated. The study found that: location has significant positive effect on on-time delivery and that product delivery mode has significant positive effect on on-time delivery. The study recommends that fresh fruit and vegetables firms should use good location and suitable logistics activities to enhance effective last mile delivery and ensure on time delivery; and adopt alternate delivery metrics of products with short traveling distance to achieve on-time delivery.

Keywords: delivery mode, last-mile, location, logistics.

INTRODUCTION

Urbanization, industrialization, technology development, economic development and market globalization have led to rapid changes in diet and lifestyle in the past decade (Maiyaki and Garbati, 2014). These rapid changes are experienced in both Delta State and Rivers State, Nigeria. Transportation ensures efficient product delivery to the final consumer and that the ultimate customer needs are served better, and the organization yields higher returns.

Due to the importance of fresh fruits and vegetables, individuals and organizations are involved in this business and make use of logistics in delivering the products to consumers/customers. Given the high population of Nigeria (about 131 million as at 2017) and the demand for fruits and vegetables, the need for last mile logistics became necessary in the delivery of fresh fruits and vegetables. Direct-to-consumer service delivery has been on the rise. The very last step in the delivery process is the process of delivering the ordered product to the consumer. This step is generally called the last-mile and is defined as the final leg in a business-to-consumer delivery service whereby the consignment is delivered to the recipient, either at the recipient's home or at a collection point (Gevaers, Vanelander & Van de Voorde, 2011; De Souza, Goh, Lau, Ng and Tan, 2014).

To Boyer, Prud'homme and Chung (2009), the concept of 'last mile logistics' is often used in areas such as urban freight delivery, e-commerce, grocery delivery and the delivery part of the supply chain. Last mile logistics is the last part of a delivery process. It involves a series of activities and processes that are necessary for the delivery process from the last transit point to the final drop point of the delivery chain. DHL International GmbH (2011) described last mile as the 'last step' in the parcel delivery. Wohlrab, Harrington and Srari (2012) defined last mile logistics as the last part of a business to consumer delivery process. It takes place within a predefined delivery route; including the upstream logistics to the last transit point in carrying fresh fruits and vegetables to the final demand destination of customers' receipt.

New solutions for the last-mile logistics have been developed in order to increase efficiency for ultrafast deliveries. Literature has focused on vehicle routings (Cleophas & Ehmke, 2014), delivery designs like reception boxes (Punakivi, Yrjölä, & Holmström, 2001), pick-up-points and locker banks (Allen, Thorne, & Browne, 2007), and crowd sourced transport (Paloheimo, Lettenmeier, & Waris,

2014; Chen, Pan, Wang, & Zhong, 2016). The mode of transportation (delivery mode) of fresh fruits and vegetables has been linked to be a cause of damage and loss in fresh produce and consequently sales. This is because of the vibration resulting in the transport vehicles as they traverse undulation and irregularities on the roads (Jones, Holt & Schoorl, 1991). This shows that currently, same-day deliveries in the last-mile are not economically nor environmentally sustainable. Therefore, the delivery of the final product to the customer's door is logistically challenging.

The general objective of this study was to examine the relationship between last mile logistics on on-time delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria. The specific objectives are to:

- (i) Determine the relationship between location and on-time delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria.
- (ii) Examine the relationship between delivery mode and on-time delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria.

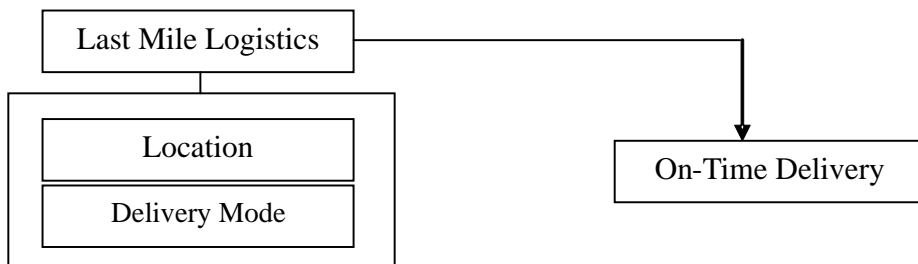


Figure 1: Conceptual framework of last mile logistics and on-time delivery

Source: Desk Research, 2020

The following research hypotheses were stated in a null form as to ascertain if there is any significant relationship between dimension of last mile logistics and on-time delivery fresh fruits and vegetables in Delta State and Rivers State, Nigeria.

H₀₁: There is no significant relationship between location and on-time delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria.

H₀₂: There is no significant relationship between delivery mode and on-time delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria.

LITERATURE REVIEW

Theory of Constraints

The theory of constraints (TOC) had been widely known as a management philosophy aimed to initiate and implement breakthrough improvement through focusing on a constraint that prevented a system from achieving a higher level of performance (Cyplik, Hadas , & Doman ski, 2009). The TOC paradigm essentially stated that every firm should have at least one constraint (Simatupang, Wright, & Sridharan, 2004). Several constraints are likely in logistics management such as very long lead times, large number of unfulfilled orders, high level of unnecessary inventories and/or lack of relevant inventories, wrong materials orders, emergency orders and frequent changes related to initial orders, which create schedule conflicts of the resources (DosSantos, Marins, Alves and Moellmann, 2010).

As pointed by Simatupang, et al. (2004), firms shared responsibilities and benefits with their upstream and downstream partners in order to create competitive advantage. When all the supply chain's partners were integrated and act as a homogenous entity, profit and performance was enhanced throughout the combination of supply and demand (DosSantos, et al., 2010). Flores & Primo (2008) affirmed that, with the uncertainty requirement of the market, the last mile logistic process became more and more complex and with much higher levels of demands, especially when related to achieving on-time delivery.

Despite the noticeable performance improvement of the logistics, the main problem observed was that last mile logistics activities had not been achieving better results related to on-time delivery in achieving profitability and efficiency. TOC thus encouraged logistics managers to identify what was preventing them from moving towards their goals as well as necessary conditions and find solutions to overcome the limitation. In this study, - transportation, inventory, order processing and information flow where dependent constraint elements in examining last mile logistics and on-time delivery of fresh fruits and vegetable in Delta State Nigeria.

Last Mile Logistics

In today's highly competitive environment, many companies are striving to gain a share of the global market and to take advantage of higher production and sourcing efficiency. A key determinant of business performance nowadays is the role of logistics management functions in ensuring the smooth flow of materials, products and information throughout the company's supply chain (Kilasi, et al., 2013; Bagshaw, 2017). Logistics management has been growing in various areas. For firms, logistics management helps to optimize the existing production and distribution processes based on the same resources through management techniques for promoting the efficiency and competitiveness of enterprises (Tseng, et al., 2005).

Logistics management plays an important role of adding competitive advantage to a firm in customer support and business excellence (Buyukozkan, et al., 2008). Effective logistics management provides the right product in the right place at the right time that is why it has received much attention over the past decade from practitioners and government (Tilokavichai & Sophatsathit, 2011). The support functionality of logistics warehousing, materials handling, and packaging also represents an integral part of a last miles logistics operating solution (Bowersox, Closs & Cooper, 2010).

Location: Location is the place where a firm decides to site its operations. Location decisions can have a big impact on costs and revenues. A business needs to decide on the best location considering, factors such as: Customers. This means that for a last mile logistics business, location plays a very significant role in providing competitive advantage. Firms throughout the world are using the concepts and techniques to address the location decision because location greatly affects both fixed and variable costs.

Location options include (1) expanding an existing facility instead of moving, (2) maintaining current sites while adding another facility elsewhere, or (3) closing the existing facility and moving to another location. The location decision often depends on the type of business. For industrial location decisions, the strategy is usually minimizing costs, although locations that foster innovation and creativity may also be critical. Warehouse location strategy, however, may be driven by a combination of cost and speed of delivery; and firms undertaking on-time delivery services come under require speed and low cost to deliver fresh fruits and vegetables that have short life span, or they must have the soft methods to preserve them for their customers.

It is expected that firms locate near their raw materials and suppliers because of (1) perishability, (2) transportation costs, or (3) bulk. Fresh fruits and vegetables and frozen seafood processors deal with perishable raw materials, so they often locate close to suppliers. In discussing business choices of location, both manufacturing and service organizations also like to locate, somewhat surprisingly, near competitors.

Delivery mode: Product quality, on-time delivery and manufacturing flexibility are main competitive factors for manufacturers today (Bagshaw, 2015). It is critical to accurately determine and maintain delivery times and quantities of incoming customer orders. Moreover, with the advent of just-in-time (JIT) and its focus on lead time reduction and elimination of inventories, the use of material requirement planning (MRP) for order promising and for internal capacity planning and control has decreased (Bagshaw, 2017).

A recent trend in manufacturing is to reduce inventory and deliver the right quantity on-time. If delivery times can be accurately estimated for execution of delivery plans, the necessity for safety stocks diminishes. Most of the studies dealt with localized improvements such as economic lot size, scheduling and forecasting and inventory management, but the entire product development process was not taken into consideration in improving on-time delivery performance. Therefore, even though there were reductions in lead times, there was always a difference between the planned and actual lead times (Bagshaw, 2015). Delivery time is the time taken to deliver a purchase product to consumer. Here it refers to the distribution of fresh fruits and vegetables in Delta State and Rivers State, Nigeria when it is announced to the buyer about the arrival of his or her goods and services at the door post or where specified at the time of purchase and where the last mile will end to complete the receipt of the product. Delivery mode as such identifies with the features and nature of delivery and the methods through which products are transferred or transported to their planned destinations. It details specific features and forms depending on the goods or product as well as the estimated time for transportation.

On-Time Delivery (OTD)

Product quality, on-time delivery and manufacturing flexibility are main competitive factors for manufacturers today (Karim et al. 2009). It is critical to accurately determine and maintain delivery times and quantities of incoming customer orders. According to Jack and Powers, (2015), on-time delivery rarely

refers to a specific date; it usually refers to range of dates defined as X days before (early) and Y days after (late) of the given due date. Ivens, et al (2013) posited that two main factors influence the on-time delivery window which is production line requirements and cash flow. If a particular delivery is expensive, delivery date can be planned for delivery very close to the throughput time of production so that delivery date cannot be late. Since it is expensive it cannot be early, so a tight window is appropriate. If an item is inexpensive and planned in bulk, it can arrive within a very wide window and be considered on time (Heinonen, 2015). This implies that whatever position of giving a due date the producer or supplier should take into cognizance the 'need time' of the customer and clearly understand the supply base.

The advent of just-in-time (JIT) and its focus on lead time reduction and elimination of inventories, the use of material requirement planning (MRP) has affected the decision on on-time delivery. Vastag and Whybark (2005) have investigated the effect of successful inventory management practices on manufacturing performance and on-time delivery. However, they found only a weak relationship of inventory management and overall company performance. Their study suggested that it takes more than inventory management to achieve higher levels of on time delivery performance. The essence is to reduce inventory and deliver the right quantity on-time. If delivery times can be accurately estimated for execution of delivery plans, the necessity for safety stocks diminishes. Moreover, due to the high pace of technological innovations, product design changes rapidly and consequently inventory items may become obsolete quickly. Following, Zhao, Droge & Stank (2001), developed an events-handling process and integrated job shop scheduling model to deal with the delivery date when events such as rush orders or machine breakdown occur during the production process in a job shop.

The challenge of on-time delivery is the starting point, but over time measuring on-time delivery is the real challenge. Reliable statistics that everyone, internal and external to the organization, can count on are the only statistics worth tracking. Heinonen (2015) stated some of the challenges as:

Working days vs. calendar days - does given due dates of delivery include weekends, holidays? This depends if the organization has work plan of working all days of the week. Often the working day or calendar day decision will affect the entire planning and scheduling of production runs.

Ship date vs. dock date - does the date used to measure OTD refers to the date the item is shipped, or the date the item is received? The best practice is the dock date that is the date the item is received. The supplier should be accountable to consider transit times when determining what ship date, they will need to make in order to supply the material within the OTD window.

Promise date vs. required date - promise date is the date the supplier or producer has promised to deliver the item; and the required date is the delivery date needed by the customer. The promise date is mostly accepted as it is the promised date that the supplier or producer can be held responsible. The promise date (the original delivery date) can be altered at some point during the order process by either the customer or supplier/manufacturer and will then be substituted with a revised promise date. Thus, in accepting on-time delivery date both the original and revised promised date is permissible in meeting expected delivery date.

Last Mile Logistics and on time Delivery

Last mile signifies the last segment of a delivery process, which is often regarded as the most important as it indicates the final delivery step of the product to the customer. It elapses the delivery process and accounts for the timing of delivery due dates. It takes place from the order point to the final customer's destination point (commonly indicated by the customer). Kumar (2008) suggests that the unique characteristics of grocery products such as the perishability of food items coupled with home delivery have challenged even the most experienced logistic and supply chain managers. Hence, for fresh fruits and vegetables retailers to be genuinely successful, they have to critically evaluate the unique logistical requirements of fresh fruits and vegetables retailing, as these requirements will shape the trends of logistics in the last mile of the supply chain on the basis of on-time delivery.

Location and on time Delivery

Organizations use time-based competition to gain a competitive advantage by delivering products and services faster and more accurately to locations than their competitors. Subsequent studies address delivery to locations as a strategic priority and argue that time is a fundamental dimension for effective manufacturing operations (Stank, et. al. 2005; Stalk & Hout, 1990). To many firms, delivery is as important as productivity, quality, and innovation (Stalk and Hout, 1990). These studies highlights that manufacturing firms consider on-time and accurate delivery to locations as a critical competitive capability.

Adopting timely and accurate delivery to locations as a manufacturing strategy necessitates tactics to reduce lead time (Fisher et al., 1994). Yet, lead time reduction only tackles part of the overall problem. Managers also must focus on accurate response tactics, in which managers leverage knowledge about forecasting inaccuracies and drivers of unpredictable demand to improve delivery accuracy (Fisher et al., 1994). Among these are location and on-time delivery that innovation of last mile logistics had introduced to the supply chain management.

Delivery Mode and on time Delivery

Delivery Mode is one of five supply chain processes (plan, source, make, deliver, and return) found in the Supply Chain Operations Reference-model (SCOR) (Stephens, 2001). Delivery lead time to the end customer in a supply chain is defined to be the elapsed time from the receipt of an order by the supplier to the receipt of the product ordered by the customer and is composed of a series of internal (manufacturing and processing) lead times and external (distribution and transportation) lead times found at the various stages of the supply chain. The timeliness of delivery is a key concern to customers and numerous empirical studies have documented the importance that on-time delivery plays in the operation of the supply chain (Iyer et al., 2004). The delivery process within an integrated supply chain is important in establishing competitive advantage.

Furthermore, given the direct impact that the timeliness of delivery has on customer satisfaction, improving the performance of the delivery process is a key concern of supply chain and logistics managers in a last mile on time delivery (Forslund & Jonsson, 2013). Delivery performance is a key metric for supporting operational excellence of supply chains and is classified as a strategic level performance measure (Gunasekaran et.al., 2004). Furthermore, Gunasekaran et.al, (2004) characterize delivery performance as the most important metric in a supply chain since it serves to integrate and involve the measurement of performance throughout the stages of the supply chain. Cost-based models that translate time-based delivery performance measures into financial based delivery performance metrics serve as a precursor for identifying and managing improvements in delivery in the delivery process (Guiffrida & Nagi, 2006). The current set of supply chain delivery performance models assume that the position of the delivery window is fixed and make no attempt to find the optimal position of the delivery window. The objective of this paper is to determine the optimal delivery mode which minimizes the expected cost of untimely (early and

late) on-time delivery.

METHODOLOGY

This study adopted the survey design with quantitative research methodology with the purpose of eliciting information from the population of 200 business owners engaged in fresh fruit and vegetable supplies in answering the research questions and to test the formulated research hypotheses (Ahiauzu & Asawo, 2016). Participants for the study were purposively selected in line with the target population of interest; hence the study was carried out as a census with all identified units covered and assessed as cases in the study. The structured questionnaire was adopted as the tool in generating data for the study. Instrumentation for each variable was based on existing measures provided by previous empirical studies (Tseng, et al., 2005, Mena, & Stevens, 2010). Instruments were further subjected (post-field work and coding) to the Cronbach reliability test with a threshold set at 0.70 as recommended by Nunally, (1978). The results revealed that all reliability coefficients for the adopted instruments were higher and reliable ($\alpha > 0.70$) hence all instruments were considered as adequate, replicable and substantial in addressing the variables of the study. The responses obtained from the respondents in research questionnaire were analyzed within a significance level of 0.05 and Stata version 13 was used as the statistical package for data analysis. The analysis of data comprises of descriptive statistic, correlation and OLS multiple regression to establish the association and statistical relationship between last mile logistics and on-time delivery of fresh fruit and vegetables in Delta State and Rivers State, Nigeria.

DATA ANALYSIS AND RESULTS

Decision Rule: The null hypotheses shall be accepted if the level of significance (p-value) is greater than 0.05, that is, if the p-value is less than 0.05 the null hypothesis (H_0) is rejected.

Table 1: OLS linear regression result of Location as independent variable and On-time delivery as dependent variable

Source	SS	df	MS	Number of obs = 200		
Model	59.9696501	1	59.9696501	F(1, 198)	=	949.13
Residual	12.5103499	198	.063183585	Prob > F	=	0.0000
				R-squared	=	0.8274
				Adj R-squared	=	0.8265
Total	72.48	199	.364221106	Root MSE	=	.25136

otdl	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
lctn	.9399632	.0305104	30.81	0.000	.8797962	1.00013
_cons	.2216575	.1316372	1.68	0.094	-.0379335	.4812484

Table 1 shows location and its contributions to on-line delivery (Coef. = 0.9399, $p = 0.000 < 0.05$), and since the p-value is less than 0.05, the null hypothesis is rejected; therefore, there is a significant positive relationship between location and on-time delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria.

Table 2: OLS linear regression result of Delivery mode as independent variable and On-time delivery as dependent variable

Source	SS	df	MS	Number of obs = 200		
Model	29.9608168	1	29.9608168	F(1, 198)	=	180.23
Residual	32.9141832	198	.166233249	Prob > F	=	0.0000
				R-squared	=	0.4765
				Adj R-squared	=	0.4739
Total	62.875	199	.315954774	Root MSE	=	.40772

otdl	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
dlmd	.642936	.0478906	13.43	0.000	.548495	.737377
_cons	1.448951	.2050924	7.06	0.000	1.044506	1.853397

Source: Survey data, 2020

The regression result in Table 2 showed that delivery mode has a significant effect on on-time delivery (Coef. = 0.6429, $p = 0.000$). The p -value = 0.000 is less than 0.05, the null hypothesis is rejected; there is a positive significant relationship between delivery mode and on-time delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria.

DISCUSSION OF FINDINGS

The result as indicated in Table 1, Adj. R-squared of the model is 0.8265 implies that location has 82.65% influence on on-time delivery and that the outcome of on-time delivery as the dependent variable is explainable by the independent variable (location). These findings concur with (Casey, Rao, Mantilla, Pelosi, and Thompson, 2014) that location affect the timely and accurate delivery of product demand and are seen as a manufacturing strategy to reduce lead time. This finding is further supported by (Song, Cherrett, McLeod & Guan, 2009; Casey, et.al, 2014) that manufacturing firms consider on-time delivery as a critical competitive capability and to many firms, on-time delivery is as important as productivity, quality, and innovation.

The findings as demonstrated on Table 2 showed that the Adj. R-squared of the model is 0.4739 implying that 47.39% change in the dependent variable (on-time delivery) is brought about by the independent variable (delivery mode). Following, Iyer et.al., (2004) that product delivery mode has a significant positive effect on on-time delivery, and delivery performance is acknowledged as a key metric for supporting operational excellence of supply chains and is classified as a strategic sales performance.

CONCLUSION AND RECOMMENDATIONS

The study aimed at assessing the relationship between last mile logistics on delivery of fresh fruits and vegetables in Delta State and Rivers State, Nigeria. Last-mile deliveries to customers are often performed to meet customers' delivery time expectations in terms of receiving the product at the required time. Product delivery by suppliers are affected by the location and mode of delivery as dimensions of last mile logistics; which go through the long chain of production, handling and transportation to their final destinations and on-time. Location has significant positive effect on on-time delivery. This means that for a last mile logistics business, location plays a very significant role in meeting product orders on time providing competitive advantage. Again, product delivery mode has significant positive effect on on-time delivery. Delivery Mode is one of five

supply chain processes (plan, source, make, deliver, and return) found in the supply chain operations. It is method by the supplier to the receipt of the product ordered by the customer and is composed of a series of internal factors - manufacturing and processing throughput times; and external factors (distribution and transportation) of the supply chain. Therefore, last mile logistics plays an important significant positive role in the operation of the supply chain by ensuring on-time delivery.

Consequently, the study recommends as follows:

1. Logistics and Transport firms in the business of fresh fruits and vegetables should ensure location of storage facilities are close to their final customers' destinations as to enhance effective delivery timeframe.
2. Logistics and Transport firms in the business of fresh fruits and vegetables should introduce mobile refrigeration to safe guard products' short shelf life to ensure customer satisfaction.

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