

Analysis of Information and Communication Technologies (ICT) Usage on Logistics Activities of Manufacturing Companies in Southwestern Nigeria

Somuyiwa Adebambo and Adebayo Toyin

Department of Transport Management, Ladoke Akintola University of Technology,
P.M.B. 4000, Ogbomoso, Oyo State, Nigeria.

Abstract

The research aims to analyze the impact of ICT usage on logistics activities of manufacturing companies. The business environment today has been undergoing unprecedented change and many companies are seeking new ways to stand out from the competition by sustaining their competitive advantage. In today's highly competitive global marketplace, the pressure on organization's to find new ways to creating and delivering value to customers is growing stronger. ICT is today being applied in many organizations in a wide range and operations areas. One hundred manufacturing companies, basically medium/large companies formed the sample of the study based on random sampling technique. Apart from the descriptive statistics adopted, data analysis was done using SPSS to obtain the correlation coefficient of variables. The study revealed that there were strong relationships between ICT usage and Logistics activities, although managers recognize the importance and need of ICT adoption for building and enhancing their competitive advantage, adoption of their ICT tends to reduce operating costs more than improve service levels. The research recommends that Government should facilitate manufacturing companies' gainful participation in global value chains through policy initiatives in specific areas by promoting technological upgrading and facilitating of compliance procedures through adoption of process and products standards.

Keywords: impact, ICT, logistics, manufacturing firms, competitive advantage

INTRODUCTION

Information and Communication Technology are fast becoming one of the main drivers of change, posing new strategic challenges (Somuyiwa, 2010). The business environment today has been undergoing unprecedented change and many companies are seeking new ways to stand out from the competition by sustaining their competitive advantage. In today's highly competitive global marketplace, the pressure on organization's to find new ways to creating and delivering value to customers is growing stronger. ICT is today being applied in many organizations in a wide range and operations areas. It has provided new ways to store, process, distribute and exchange information both within companies and with customers and suppliers in the supply chain (Somuyiwa and Oyesiku, 2010).

It is now commonly accepted that information and communication technologies (ICT) and systems provide many benefits to companies, including small and medium enterprises (SME), to make them more efficient, effective and competitive (Chapman, et al, 2000; Sarkis, et al, 2004; Fink and Disterer, 2006). Many companies conduct business using electronic commerce (e-commerce), whether focusing on business-to-business (B2B) or business-to-consumer (B2C) activities. They realize that easy access to information and communication and the delivery of

their products or services are important drivers in developing and sustaining market competitiveness nationally and internationally. Having a supportive electronic logistics (e-logistics) system is very important to maintain the company's competitiveness (Sarkis, et al, 2004). e-Logistics is an emerging area of logistics field. Alike other emerging disciplines, there is not a widely accepted definition yet. It may be that the term defines a unique subset of ICT and transport logistics, or that is a redundant term, which duplicates many similar terms in use. There is a rapid development in the use of information and communications technology (ICT) in logistics management. The application of computers, internet and information communication systems can be seen in virtually all activity in the logistics industry, such as transportation, warehousing, order processing, materials management, and procurement. It can help companies to achieve competitive advantages by providing customers with superior services. The source of competitive advantage is found in the ability of the organization to differentiate in the eyes of the customer, from its competition and again from operating at lower cost and hence at lower cost and greater profit. Successful companies either have a productivity advantage that gives a lower cost profile or they have a value advantage that gives the product or offers a differential over competitive offerings or a

combination of the two. Companies are no longer staying competitive simply through focusing on product quality and pricing as customers are becoming higher demanding related to customer service offer. This issue directs the companies' main focus today to address the customer needs in the ever-changing environment. In order to be the winners in the marketplace, timing and superior customer service are becoming the keys to attain competitive advantage for a company. Time-based competition is an important issue that many companies are facing currently as customers are becoming more time-sensitive and time-oriented in terms of better services, reliability and delivery. The ways to renew the customers' services and how they are delivered are critical capabilities for many companies to acquire nowadays. This leads to increasing interaction between marketing and logistics where logistics is considered a platform for supporting new strategic moves on the market (Kazak and Wing, 2009).

As an increasing number of firms are under pressure from their partners to change both their traditional styles of operation and organization to replacing them with integrated systems that help increase the speed and fluidity of physical and information flows, reaching this kind of integration therefore requires investing on new Information and Communication Technologies (ICT). With the advancement of ICT, many companies have adopted the use of the technologies to improve the efficiency and effectiveness of their activities (Somuyiwa, 2010). In the light of this, the research examines the impact of ICT usage on logistics activities of manufacturing companies in Southwestern Nigeria.

MATERIALS AND METHODS

Methodology

The methodology for this study was based on the sample which was randomly selected consisting of 100 manufacturing companies. The companies are those in Food, Beverages & Tobacco (FBT) sector, Pulp, Paper and Paper Products (PPP) sector, and Plastic & Rubber Products (PRP) sector in Southwestern Nigeria. The choice of these industrial sectors was predicated their prominence in the study area. Similarly, their products directly affect people's life such that they have socio-cultural implication, especially their rate of consumption. Above all, the sectoral groups are relatively most quoted sectors at the stock market; consequently, accessibility to information about it was not problematic. The data collected were analyzed using descriptive (means) and inferential (correlation) statistical analysis. The main instrument used in collecting data was questionnaire, which was self-administered by the managers of the companies. The study employed both primary and secondary sources of data. The questionnaire, which was based on a five point likert

scale, was used to collect information about ICT usage and the logistics activities of the manufacturing companies. That is, the types, and level of ICT application complexity as well as the effect of ICT on the Logistics activities of the manufacturing companies.

Study Area

South-Western part of Nigeria lies between latitude 6°N of the equator and longitude 3°E and 5°E of Greenwich Meridian Time (GMT). The zone consists of six states. These are Lagos state that stretches along the seaboard, Ogun, Oyo, Osun, Ondo and Ekiti state. The South-Western Geo-political Zone occupies an area of 79,048 km². The zone covers about one-twelfth of Nigeria and into it are packed almost 25 million or about one-fifth of the entire population of the Country. The area is washed in the south by the Gulf of Guinea. On the east, it is bounded by the South-Eastern Nigeria. On the west, it shares a common frontier with the republic of Guinea and on the North; it is bounded by the North Central Geo-political Zone that consists of Kwara State, Kogi State, Niger State and others. The majority of the people in the South-Western Nigeria are Yorubas, which occupies major urban centres of this Geo-political Zone (Somuyiwa, 2010).

LITERATURE REVIEW AND CONCEPTUAL ISSUES

The Changing Logistics Environment

Logistics refers to the art of managing the flow of physical material and information from the source to the user. It encompasses all of the information and material flows throughout an organization and inter-organizations. It includes everything from movement of a product or from a service that needs to be rendered, through to management of incoming raw materials, production, storing of finished goods, its delivery to the customer and after sales service. The role of logistics function is a key determinant of business performance to ensure that there is smooth flow of material and information throughout a company's supply chains. Logistics has also become more prominent as a critical success factor in competitive advantage through reducing costs and improving service level or responsiveness to customers. Problems arising in small firms include delayed and inaccurate information, incomplete services, slow and inefficient operation, and a high product damage rate (Somuyiwa, 2009 and Somuyiwa and Oyesiku, 2010).

Information and Communication Technology in Logistics

ICT comprises a number of technologies, which may, but need not be internet-based. In a logistics setting, Wit and Van (1996) distinguish between transaction systems, operational planning systems, and control

systems. These may be computer mediated (extranets, intranets) or based on internet or web technology:

- Transaction system: Electronic Data Interchange (EDI) is the electronic transfer of structured data by agreed message standards from one computer application, with a minimum of human intervention, connecting all parties in a supply chain), interactive telephone systems, and e-commerce, e.g. business-to-business (B2B) e-marketplaces, for the global procurement of inputs; contracting of logistics services, directly by the shipper or by the so called third-party logistic service provider (3pls); or business-to-consumer (B2C) on-line sales to consumers.
- Operational planning system: all sorts of logistic decision support and route planning software, e.g. Advanced Planning and Scheduling (APS), enabling the design, planning and operation of supply chain, including performance measurement for all participants in the chain; Enterprise Resources Planning(ERP) systems, enabling the processing, recording and fulfillment of orders, e.g. in warehouses or stores; and route planning software designed to avoid congested roads based on digital maps and real-time traffic information.
- Control system: mobile communication (phones), tracking and tracing systems (Barcode scanning for packages and pallets), tracking vehicles with Global Positioning System (GPS), measuring vehicle performance with 'black boxes' (containing logistic data), and automatic Equipment Identification (AEI).

Logistics and Information Flow

Stan and Reynolds (2001) stated that data for a logistics management information system can come from many sources. Also, Stock and Lambert (2001) define the most important sources of data for the common database, which are order processing system, company records, industry data, and management

ICT and Application for Logistics

Information sharing is an important prerequisite relevant function in the supply chain management concept, or securing information accessibility to all supply chain partners involved in logistics operations. The creation of distributed databases accelerates the development of relationships with other operators in the supply chain. In addition, information transfer which is probably the most relevant function in the supply chain management concept ensures the widespread dissemination of the internet and e-business technologies which allows to a large extent overcoming problems relating to systems and

applications interoperability. Finally, in supply chain operation planning, ICT also plays a major role to the extent that the benefits obtained from the application of SCM logic depend almost entirely on a company's capability to establish electronic links with customers, suppliers and third party logistics 3pls (Fink and Disterer, 2006). In the light of all these, the dissemination of ICT has opened up new opportunities for the development of new roles and functions in the supply chain, the so called intermediaries or on-line freight, e-market places. The purpose of these web-based intermediaries is to give added value to transport and logistics business through greater efficiency and information transparency (Somuyiwa, 2009; Somuyiwa and Adewoye, 2010 and Somuyiwa and Oyesiku, 2010). The faster information flows along the supply chain, the faster operational decisions can be made. The faster material and cash flow along the supply chain, the faster a company's money is freed from the manufacturing or procurement cycle. One of the main areas of interest that has emerged in recent years concerns the effects of ICT on logistics. In the literature, there are a plethora of research that have analyzed general aspects (Long, 2003; Lambert, 2004) and specific effects (Lovorn, 2003; ASCET, 2004) of these technologies in logistics, considering the wide range of possible effects, the attention in this chapter is focused on the supply chain efficiency improvements related to. ICT usage be analyzed with reference to three functions related to information/order processing and management, Distribution and sharing of data and information, their transfer and lastly, the processing and utilization of information for supply chain specific technologies used as a support tool for the three functions identified and summarized in Fig. 2 and Table 1.

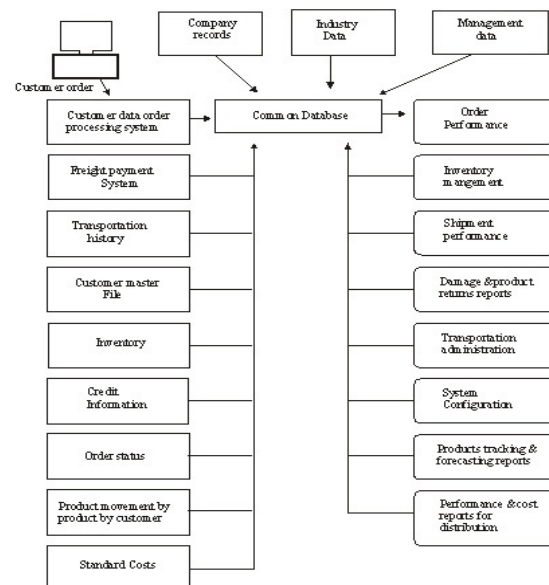


Figure 1: The logistics information flow
Source: Stock and Lambert, (2001)

Table 1: ICT and Application for Logistics

Function	Activity	ICT Technology
Sharing of Data and Information	Access and use of Data and Information by Supply Chain Partners	-Databases -Datawarehouse
Information Transfer	Communication of Information between supply chain partner	-EDI
Information use for Supply chain Planning	Data and e-document processing in Decision making and operations planning of the supply chain	-Advanced AI -CAD -CAE -ERP -MRP -Multimedia -Traditional AI

Source: Adapted from Pontrandolfo and Scozzi (1999)

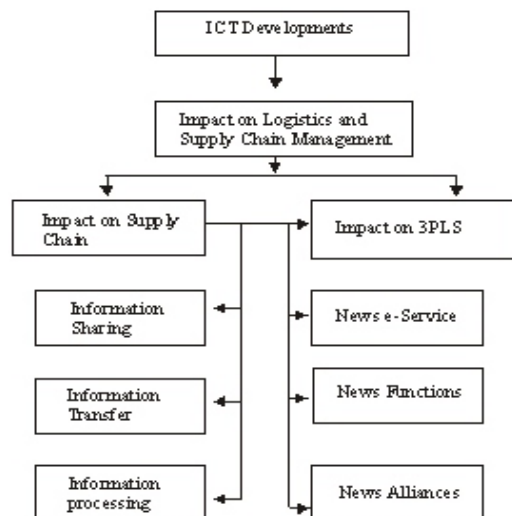


Fig. 2: Framework for analyzing the impact of ICT on logistics and SCM

Source: Adapted from Carlson (2005), Collins (2005) and Somuyiwa, (2010)

Enterprises Resources planning: Enterprises Resources Planning (ERP) is the English term for a business system. Again, another term that is used for business system is Enterprises System (ES). To described and E S in a simple way one could say that ES is an information system that manages all the resources available in a company. It is a common term for a co-operating software that manages and co-ordinates much of a company's resources, assets and activities (Boyle, 2004). Gartner Group developed the ERP concept under the 90's. The term ERP is defined by them as: "ERP is a planning and communication system that affects all the resources

of a company." Boyle (2004) defines it as: "not a system, but a framework that includes administrative (finance, accounting), human resources (payroll, benefits), and Manufacturing Resources Planning (MRP) (procurement production planning). ERP units' major business processes- order processing general ledger, payroll, and production within a single family of software modules." There can be numerous benefits using enterprises systems and according to Davenport (2002.) the most significant are:

- Cycle time reduction
- Faster information transactions
- Better financial management
- Laying the groundwork for electronic commerce
- Making tacit process knowledge explicit (transferring knowledge from an aging workforce into the ES).

But there are not just benefits with enterprises; there are also both technical and business perspectives that are negative:

- Inflexibility. One of the greatest difficulties in any ES project is to match the system to the preferred ways of accomplishing a business process or activity. It is just too difficult to fit an ES to a business-both for the first time and for subsequent changes.

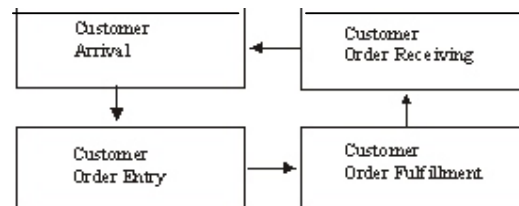


Fig. 3: Relationship among various stages of customers

Source: Adapted from Somuyiwa (2010) and Somuyiwa and Oyesiku (2010)

- Long implementation periods. 3 to 5 year project duration is fairly common for implementing an ES in large company, and for companies in the rapidly changing business world these projects are insupportable.
- Overly hierarchical organizations. A third criticism of ES's is that they impose a hierarchical, "command and control: perspective on organizations.
- Antiquated technology. A final criticism of ES's is that most are based on obsolete technology; that is, that they are thinly disguised mainframe programme ported into the client/server world.

Customer order cycle: The customer order cycle: occurs at the customer/retailer interface and includes

all process directly involved in receiving and filling the customer's order. Typically, the customer initiates this cycle at a retailer site, and the cycle primarily involves filling customer demand. The retailer's interaction with the customer starts when the customer arrives or contact is initiated and ends when the customer receives the order.

The processes involved in the customer order cycle are shown in Fig. 3 and includes:

- Customer arrival
- Customer order entry
- Customer order fulfillment
- Customer order receiving
- Customer arrival: The term customer arrival refers to the customer's arrival at the location where he or she has access to his or her choices and makes a decision regarding a purchase. The starting point for any supply chain is the arrival of a customer.

Customer arrival can occur when

- the customer walks into a supermarket to make a purchase,
- the customer calls a mail order telemarketing center, or
- the customer uses the web or an electronic link to mail order firm.

From the supply chain perspective, a key goal is to facilitate the contact between the customer and the appropriate product so that the customer's arrival turns into a customer order. At a supermarket, facilitating a Customer order may involve managing customer flows and product displays. At a telemarketing center, it may mean ensuring that customers do not have to wait on hold for too long. It may also mean having systems in place so that sales representatives can answer customer queries in a way that turns call into orders. At a Web site, a key system may be search capabilities with tools such as personalization that allow customers to quickly locate and view products that may interest them. The objective of the customer arrival process is to maximize the conversion of customer arrivals to customer order

Extent of the use of IT devices in order processing and information cost: This refers to how companies have made products and services available to customers. It also involves how various types of information technology devices are made available in each of the studied companies. The identified technologies are computer systems, electronic data transfer, electronic data interchange, magnetic ink character reader, local area network, wide area network and Electronic Resource Planning. Similarly, on the cost side, tangible, direct costs are straightforward, but there are some intangible and indirect costs that can be overlooked. The tangible costs include the direct costs of the IT product and ongoing service and maintenance, plus estimates for

consulting fees, staff training and change management, staff and resources assigned to the project, and opportunity costs. However, many estimates mean many places for poor budgets. Many IT projects come in significantly over budget because managers:

- Overlook major cost items such as operational support cost
- Use estimates that assume everything will go according to plan
- Purposely underestimate costs to secure project approval.

The three basic categories of costs are capital expenditures, one-time project expenses, and ongoing support activities. Capital expenditures are amortized over the expected life of the technology. If this amortization period exceeds the actual product life, the costs will be underestimated. One-time project fees often contain hidden costs such as fees to investigate alternative systems, training travel and lodging, data conversion and normalization, or lost productivity time when employees go through a learning curve. Ongoing support costs include annual license fees and maintenance fees for vendor support costs include upgrades, taxes on fixed assets, and IT support staff. Analytical software may have additional cost such as the cost of generating mathematical or simulation models once software is installed. It is perhaps not advisable to underestimate the cost of reallocation employees to an IT project. Just because a salaries employee is a sunk cost does not mean that this cost should be ignored in the justification. Employees should be used when the savings from long-term maintenance using experienced staff are greater than the savings of using an already seasoned consultant. A final cost to consider is the cost of not implementing the project.

RESULT AND DISCUSSION

Table 2: Perceived Benefits of Utilizing ICT

Benefits	*Mean
More accurate and timely information	4.37
Better communication and connection links	4.17
Improve promotion strategy	3.85
Reduce operating costs	3.81
Improve customer service	3.70
Reach a wider range of new customers	3.56
Keep ahead of competitors	3.54
Exchange business process data	3.31
Select suppliers faster and globally	2.94
Online ordering and payment	2.70
Keep track status of orders, production and distribution	2.54

Note: *1=Not at all, 2=To a very small extent, 3=To a small extent, 4=To a great extent, 5=To a very great extent

Source: Authors survey, (2010)

Table 3: Correlation coefficient between dependent and independent variables

Variables	r values
Increase no of on-time deliveries	0.624*(.025)
Reduce distribution cost	0.711*(.032)
Increase fulfillment rate	0.604*(.035)
Reduce product delivery time	0.596*(.040)
Monitor and keep track of the progress of distribution activities	0.594*(.041)
Reduce inventory costs	0.690*(.043)
Increase flexibility to offer different order	0.580*(.049)
Reduce inventory levels	0.579*(.050)

*Significant at 0.05 level (2-tailed) p values in bracket.

Source: Authors Survey, (2010)

Out of the 100 questionnaires administered 81% was found usable, which include 9% from Pulp, Paper and Paper products industry, 10% from Plastics and Rubber product industry, and 62% from Food, Beverage and Tobacco industry. The result of Table 2 reveals that managers recognize the importance and need of ICT adoption for building and enhancing their competitive advantage with a mean value of 3.54. Although adoption of their ICT tends to reduce operating costs more than improve service levels, it also reflects that entrepreneurs have an expectation of outcomes from ICT adoption to a high degree. It is shown in Table 3 that all the independent variables are significant at 0.05 level of significance with correlation values that are relatively more than +0.5. The import of this is that ICT usage has a significant effect on logistics activities of the sampled firms, that is, the manufacturing companies recognize the contribution and influence of ICT on their logistics activities

Conclusion And Policy Recommendations

The effective adoption of ICT has become more critical for manufacturing companies as the drive towards higher levels of logistics activities integration continues. However, the widely acknowledged critical importance of manufacturing companies in economic growth motivated the initiation of this study. Manufacturing companies generally have a positive attitude to ICT, much of which is generated by owner/manager perception that ICT can have a positive impact on operational efficiency. In keeping with much of the literature, the owner/manager had significant influence on ICT adoption. Their ability to understand and appreciate the capabilities afforded by ICT had an impact on adoption decisions.

The survey however, points to a number of key factors that inhibit the widespread adoption and use of ICT, and these include the cost of technology,

uncertainty over the business benefits and impacts, and the lack of relevant internal ICT expertise. Day to day challenges such as dependence on external consultants and vendors and the unreliability of systems, potentially owing to technological obsolescence and technical complexity, were also important constraints on ICT use.

The findings therefore have important implications for policy aimed at ICT adoption and use by manufacturing companies in the sense that Governments should facilitate manufacturing companies' gainful participation in global value chains through policy initiatives in specific areas:

Promotion of technological upgrading is critical in order to encourage manufacturing companies to capture more value added from participation in logistics activities. Policy in this area should aim to support training and capacity building via skill development programmes; promote partnerships between manufacturing companies and organizations overseas that can develop or transfer technology, products, processes or management practices; and to facilitate the technological upgrading through various financial schemes, such as credit lines for upgrading.

Facilitation of compliance procedures through adoption of product and process standards has several well-known benefits for firms. It enables them to introduce new technology and integrate business practices that ameliorate their overall performance. However, different and concurrent standards can become barriers to transmission of information and to trade. Also, the costs of compliance to required standards are proportionally too high for firms. The problem is aggravated when these firms have to cope with an increasing number of private standards set by customers in addition to mandatory ones. Governments should ensure that national certification systems do not impose an excessive burden on firms and encourage manufacturing company's participation in the standard-setting process.

Promotion of skills development as the effectiveness of aforementioned policy measures, to a certain degree, is contingent on having skilled human resources in manufacturing companies. Participation in logistics activities can accelerate manufacturing companies upgrading of human and technological resources, through technology and knowledge transfer and implementation of new business practices.

REFERENCES

Alan, R., John, O. and Phil, C. (2000) The Handbook of Logistics And Distribution Management. Pp.32-34, Glasgow, Bell & Bain Ltd.

- ASCET (2004) Achieving Supply Chain Excellence Through Technology. Vol. 6. Montgomery Research Inc., San Francisco.
- Bowersox, D., D. Gloss and M. Cooper (2002) Supply Chain Logistics Management. International Ed., McGraw Hill, New York.
- Boyle, R.D. (2004) Achieving your Supply Chain Goals: Conquering the 'First Mile' Hurdle of Data Capture. APICS - The Performance Advantage, July/August, 14(7).
- Chapman, P. James-Moore, M., Szczygie, M. and Thomson, D. (2000) Building Internet Capabilities in SMEs, Logistics Information Management, Vol. 13, No. 6, 353-359.
- Christopher, M. (1997) in Members Directory, Institute of Logistics, Corby
- Davenport, R. (2002) Handbook of Supply Chain Management. Boca Raton, St Lucie Press, Florida.
- Kazak, K., and Wing, Y. C. (2009) Improving Customer service through Just-in Time Distribution: Fitting into the Customer's service offer in case of ELECTROLUX LAUNDRY SYSTEMS. University of Kalmar-Library
<http://urn.kb.se/resolve?urn=urn:nbn:se:hik:diva-2042>
- Long, D., (2003) International Logistics: Global Supply Chain Management. Massachusetts: Kluwer Academic Publisher, Norwell.
- Lovorn, R. (2003) Building a Solid Foundation for Supply Chain Optimization. International Conference Proceedings, Alexandria, Virginia: APICS.
- Moberg, C., Cutler, B., Gross, A. and Speh, T., (2002) Identifying Antecedents of Information Exchange within Supply Chains, International Journal of Physical Distribution & Logistics Management, (32) 9: 321-328.
- Pontrandolfo P., Scozzi B. (1999), Information and Communication Technology and Supply Chain Management: a reasoned taxonomy, proceedings of the 4th International Symposium on Logistics "Logistics in the information age", 11-14 July, Florence, Italy.
- Rantapuska, T. and Ihanainen, O. (2008). Knowledge use in ICT investment decision making of SMEs, Journal of Enterprise Information Management, Vol. 21, No. 6, 585-596.
- Sarkis, J. Mdeade, L. M. and Talluri, S. (2004), E-logistics and the Natural Environment, Supply Chain Management, Vol. 9, No. 4, 303-312.
- Somuyiwa, A. O. (2009) Managing Logistics Information System. Workshop Presentation on Effective Business Logistics Management. Chartered institute of Logistics and Transport, Nigeria, South-West zone.
- Somuyiwa, A. O. (2010) Analysis of Logistics Cost in the supply Chain Management of Manufacturing Companies in Southwestern Nigeria, 2002-2006. Unpublished Ph.D. Thesis, Olabisi Onabanjo University, Ago-Iwoye.
- Somuyiwa, A. O. and Adewoye, J. O (2010) Managing Logistics Information System: Theoretical underpinning. Asian Journal of Business Management- Maxwell scientific organization. 2 (2) 41-47
- Somuyiwa, A. O. and Oyesiku, O.O (2010) Analysis of Performance of Collaborative Sharing Cost in Outbound Logistics. Current Research of Social Sciences- Maxwell scientific organization. 2 (3)181-186.
- Stan, R. and Reynolds, G. (2001) Principles of Information Systems: A Managerial Approach. Course Technology, Sweden, Memphis Continental Traffic Publishing Company.
- Stock, J. R. and Lambert, D. M. (2001) Strategic Logistics Management. 4th ed. New York McGraw Hill Irwin.
- Wit, J. DE and H. Van Gent (1996) Economic en Transport, Utrecht: Uitgeverij Lemma B.V.
- Zhang, L.J. Yadav, P. Chang, H. Akkiraju, R. Chao, T. Flaxer, D. Jeng, J. J. (2009). ELPIF: An E-Logistics Processes Integration Framework Based on Web Services, NY 10598, USA online accessed on 21.01.2009 available
<http://www.research.ibm.com/people/b/bth/OOWS2001/zhang.pdf>