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LOGISTICS INFORMATION SYSTEMS IN THE DISTRIBUTION OF FLOUR IN NIGERIA

Joseph Adeniyi Kolawole[1] , Cornelius Femi Popoola[2] and Ezekiel Morakinyo Akinseye [3]
[1]*Library, Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State, Nigeria.*
E-mail of corresponding author: jakolawole20@yahoo.com
[2]*Department of Business Administration, Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State Nigeria*
E-mail: pofec2010@yahoo.com
[3]*Department of Business Administration, Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State Nigeria*

Abstract: *This study investigated logistics information systems in the distribution of flour in Nigeria. A case study design was used and 50 staff of Honeywell Flour Mill was sampled for the study. Data generated through questionnaire were analysed using correlation and regression analysis. The findings of the study revealed that logistic information systems such as e-commerce, interactive telephone systems and electronic data interchange positively correlated with distribution of flour in Honeywell Flour Mill. Finding also deduced that e-commerce, interactive telephone systems and electronic data interchange jointly and positively contribute to the distribution of flour in Honeywell Flour Mill in Nigeria (R=.935; Adj.* R^2*= .642;* $F_{(3,47)}$*=14.739; p<.05). The study therefore recommended that Honeywell Flour Mill should upgrade their logistic information systems to computer-to-computer communication of business transactions and documents, as well adopt new technology such as, tracking-and-tracing systems (Barcode-scanning for packages and palettes), tracking vehicles with Global Positioning System (GPS), measuring vehicle performance with 'black boxes' (containing logistic data) and Automatic Equipment Identification (AEI) into their systems.*

Keywords: E-commerce, Electronic Data Interchange, Flour Distribution, Information System, Interactive Telephone Systems.

I. Introduction

In the 21st century, changes in the business environment have contributed to the development of physical distribution networks. First, as an outcome of globalization and the proliferation of multinational companies, joint ventures, strategic alliances and business partnerships, significant success factors were identified, complementing the earlier just-in-time practices. Second, technological changes, particularly the dramatic fall in information communication costs, which are a significant component of transaction costs, have led to changes in coordination among the members of the supply chain network (Coase 1998). The concept of logistics is ancient. There is nothing new about the components of the field of logistics. There have been warehousing goods since the days of ancient Egyptian grenadiers. Things have been moving by transport since people first learnt that logs float downstream. Moreover, storage has been in existence since people first discovered that, that was a way to survive long and cold winter. What is new is how it is done and which is perhaps synonymous to logistics management (Waidringer and Eng 2001). Logistics is the process of strategically managing the acquisition, movement and storage of materials, parts and finished inventory (and

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the related information flows) through the organisation and its marketing channel in such a way that current and future profitability is maximized through the cost-effective fulfillment of orders (Christopher 1992, Somuyiwa 2010, Somuyiwa and Sangosanya 2007). Logistics adds value by making products available in the right place and at the right time. If a product for instance is available at the place it is needed, logistics is said to have added place utility, if it is delivered at the right time, logistics has added time utility. Then the aim of logistics can be phrased in terms of getting the highest customer utility or perceived value. In essence, it is trying to maximise the difference between perceived value and actual costs.

Definition of systems is significant to definition of information. For instance information is that intellectual that in a certain domain can be acquired, preserved, transferred and applied as non-empty sets of information elements, such that each element determines a certain aspect entity" (Long 2003). Hence, the definition of an information system should then bed a system that can manage knowledge. An information system is a system for collection, adaptation, storage, transfer and presentation of information in an, for the users of the information system, effective way. The information system can be totally or party computerized (Lambert 2004). Logistics information system is a subsystem of management information system that provides specific information for a logistic management. As others information systems, this has a needs to transfer information (Ballou 1993). Any Information Systems is composed by 3 basic parts: data input, processing and output. The application of information technology (IT) to the logistics process and also to most areas of the companies is gradually spreading. Today, the key role of logistics information systems is clear when it is realized that, logistics consumes 35-60 per cent of systems development and operating budgets. In many companies, over 75 per cent of all payback from applications development comes from logistics-based systems. According to some estimates, by the end of the twentieth century, total expenditure in information systems for logistics by American companies might reach $25,000 million.

This development in information related activities has caused a qualitative change in physical distribution. Previously, the only information used was that required for transportation, frequently just because of a legal obligation. Currently, the management of information is conceived as a tool for customer service. As an example of this, order collection has evolved from weekly visits by salesmen to the customers, followed by mailing the orders to the regional warehouse or factory (transmission time therefore being sometimes in excess of ten days) to the current systems of continuous replenishment to distributors. With these systems, the manufacturer can manage, from the company's headquarters, the stock of its products at the shopping centre, thus improving the service level. This is achieved through the use of real demand data, captured by the point-of-sale systems through the optical barcode scanners and transmitted through an electronic data interchange (EDI) system.

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In the same token, electronic commerce and associated business-to-business transaction capabilities have changed the way in which supply chain operates. The Internet has for instance, enabled information exchange on an unprecedented scale, often at a pace too fast for normal consumption. Hence, companies are now equipped to make effective use of data, from warehouse management systems, which contain information on supplier/customer warehouse inventory levels and key customer ordering patterns and transportation management systems within which information pertaining to the location of important supply chain assets, such as products or vehicles is typically stored. The integration of these systems leads to global inventory visibility which, in turn, leads to reduced costs and improved customer services by decreasing shipping and receiving cycle times, increasing shipment and inventory accuracy, and decreasing lead time variably that all have impacts on logistics cost (Moberg 2002, Somuyiwa, 2010).

Organizations increasingly find that they must rely on effective supply chains, or networks, to compete in the global market and networked economy. In Peter Drucker's (1998) new management paradigms, this concept of business relationships extends beyond traditional enterprise boundaries and seeks to organize entire business processes throughout a value chain of multiple companies. During the past decades, globalization, outsourcing and information technology have enabled many organizations, such as Dell and Hewlett Packard, to successfully operate solid collaborative supply networks in which each specialized business partner focuses on only a few key strategic activities (Scott 1993). This inter-organizational distribution network can be acknowledged as a new form of organization. However, with the complicated interactions among the players, the network structure fits neither market nor hierarchy categories (Powell 1990). It is not clear what kind of performance impacts different logistics information network structures could have on firms, and little is known about the coordination conditions and trade-offs that may exist among the players. From a systems perspective, a complex network structure can be decomposed into individual component firms (Zhang and Dilts 2004). Traditionally, companies in a distribution network concentrate on the inputs and outputs of the processes, with little concern for the internal management working of other individual players. The choice of an internal management control structure is known to impact local firm performance. Therefore, this study hereby examined the effect of logistics information systems in the distribution of flour in Nigeria.

II. LITERATURE REVIEW

2.1 Concept of Physical Distribution

Physical distribution has become one of the major strategies to improve organizational performance and generate competitive advantage (Fisher 1997). A variety of changes in the business environment including time-based competition, fast product cycle, just-in-time production, cost leadership, use of interorganizational systems, and global competition have fueled interest in physical distribution. The growth in business-to-business (B2B) commerce has highlighted the role of physical distribution in the modern digital economy. Physical

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distribution encompasses many activities, but for the purposes of this study, it is defined as the integration of all activities associated with the flow and transformation of goods from new materials, through to the end user, as well as associated information flows, through improved supply chain relationships to achieve a sustainable competitive advantage (Handfeld and Nichols 1998). This definition clearly identifies the two major flow components of the physical distribution: Materials and Information.

The growth in inter-organizational systems (IOS) has made it possible to have electronic flow of information across the supply chain. Another definition of physical distribution from a business-process perspective that highlights the role of interorganizational systems is "Integration of business processes from end user through original suppliers that provides products, services, and information that add value to customers." Supply chain management reengineers the chain and adds value by exploiting the information in the value chain. A supply chain is a series of linked suppliers and customers that takes a basic raw material at one end and delivers a finished product to the ultimate end user at the other end. The supply chain can be decomposed into many levels. There could be a single-level supply chain that includes only the focal firm's immediate set of suppliers and customers, or one could go down in levels to include the raw material supplier on one end and the disposal of used finished product at the other end. Each customer and supplier in the chain has many supply chains with its own suppliers and customers. A small change in any of the partners' supply chain, or a weak or broken link in the web, can create a major reaction in the entire chain.

Since most organizations have neither the control nor the resources to monitor the entire web, they normally restrict their focus to one or two levels. There are three components flowing through the physical distribution: goods and services in one direction, payments in the other direction, and information in both directions. Sometimes payments are shown as an information flow and not as a separate flow, although the characteristics are different and require different set of entities. To facilitate the movement of these three components, the service of other entities is required. While transportation carriers and logistics firms are used for movement of goods, supermarkets and financial institutions are used for movement of payments. Information flow can occur between the entities directly or through an outsourcer or third party. In recent years, direct links between firms are becoming more popular than third party links.

2.1.1. Inter-organizational Systems

Information flow between organizations has existed ever since human beings traded their goods and services. What is unique about the current environment is the availability of a communications infrastructure to electronically transfer information, with minimal effort and time lag, resulting in the easy availability of information. Interorganizational systems, also called extranets, are application systems that link various partners in the supply chain using a public or private telecommunications infrastructure. These systems provide the ability for computer-to-computer

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communication of business transactions and documents. Interorganizational systems became popular with the introduction of electronic data interchange (EDI). Although EDI has been in existence for more than 20 years, it is only during the past five to ten years that it has been widely used. There are basically two types of interorganizational systems: electronic dyad (i.e., a system that exists between two firms) and electronic networks or multilateral information systems.

2.1.2 Electronic Integration Issues

Electronic integration along with free flow of information among the supply chain partners opens up a wide range of business opportunities (Clark and Lee, 1997). However, implementation is not always easy; there may be resistance, because integration may not provide the same level of benefits to all partners. Typically, EDI has been implemented in a husband- spoke arrangement, where the initiator (hub) takes proactive steps to get the smaller firms (spokes), mostly suppliers, to adopt interorganizational systems. They may even coerce the spoke firms into adopting EDI by using veiled threat of loss of business. Studies have found that the initiator tends to gain more at first, but in the long run, all parties benefit from the implementation. A similar situation is found in the implementation of a supply chain, where a firm normally takes a proactive lead to integrate the chain (Handfeld and Nichols, 1998).

2.2 Logistics and Information Technology

In 1986, the Council of Logistics Management (CLM), the leading-edge professional organization with a current membership of over 13.000 defined logistics management as: "The process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and related information, flow from point-of-origin to point –of-consumption for the purpose of conforming to customer requirements (Lambert, 1998). The application of information technology (IT) to the logistics process (and also to most areas of the companies) is gradually spreading. Today, the key role of logistics information systems is clear when it is realized that logistics consumes 35-60 per cent of systems development and operating budgets. In many companies, over 75 per cent of all payback from applications development comes from logistics-based systems. According to some estimates, by the end of the twentieth century, total expenditure in information systems for logistics by American companies might reach $25,000 million. This development in information related activities has caused a qualitative change in distribution. Previously, the only information used was that required for transportation, frequently just because of a legal obligation. Currently, the management of information is conceived as a tool for customer service. As an example of this, order collection has evolved from weekly visits by salesmen to the customers, followed by mailing the orders to the regional warehouse or factory (transmission time therefore being sometimes in excess of ten days) to the current systems of continuous replenishment to distributors. With these systems, the manufacturer can manage, from the company's headquarters, the stock of its products at the shopping centre, thus

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improving the service level. To achieve this, it can use real demand data, captured by the point-of-sale systems through the optical barcode scanners and transmitted through an electronic data interchange (EDI) system.

2.2.1 Technology as support for Logistics

In according to Laudon and Laudon (2001) there are some Logistics Information Systems which can support the business, such as: electronic data interchange (EDI), enterprise resource planning (ERP), satellite tracking, decision support systems, internet, optimal barcodes etc. Logistics information system (LIS) is also described as a subsystem of management information system, that provide specific information for a logistic management (Ballou 1993). As others information systems, this has a needs to transfer information. Any Information Systems is composed by three (3) basic parts which are: Data input, Processing and Output.

2.3 Information and Communication Technology in Logistics

ICT's comprises a number of technologies, which may, but need not be internet-based. In a setting of logistics Bowersox et al (2002) distinguish between transaction systems, operational planning systems, and control systems. These may be computer mediated (extranets, intranets) or based on Internet or web technology:

2.3.1 Transaction system

Electronic Data Interchange (EDI, the electronic transfer of structure 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 logistic services, directly by the shipper or by a so-called third-party logistic service provider (3Pls); or Business-to-Consumer (B2C) on-line sales to consumers (Laudon and Laudon 2001).

2.3.2 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; Enterprises 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.

2.3.3 Control System

Mobile communication (phones), tracking-and-tracing systems (Barcode-scanning for packages and palettes), tracking vehicles with Global Positioning System (GPS), measuring vehicle performance with 'black boxes' (containing logistic data) and Automatic Equipment Identification (AEI). A coherent analysis of the impact of ICTs in the logistic industry should thus deal with control and planning (e-fleet management) as well as transaction (e-commerce and e-logistics) systems, whether these are internet or web-based or not. However, we may focus on internet and web-based system, for the practical reason of data and literature availability, because ED I is a relatively expensive-often excluding small firms (E-Business Watch 2002) and closed system, thus losing ground to the open standard of relatively cheap internet technology, and

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mostly because e-commerce (for worldwide procurement and/or sales) is so closely related with e-logistics (the use of the internet for contracting logistic functions) and e-fleet management (the use of the internet for managing logistic functions), If we take into account the various forms of Intelligent Transport Systems (ITS)- a term commonly used to refer to the application of ICT to enhance the efficiency of the existing of the exiting road infrastructure (Smith et al 2001).

2.4 Logistics and Information Flow

The stream of data in different directions with variable contents between various databases (departments) within a company is defined as information flow. According to Stair and Reynolds (2001) data for a logistics management information system can come from many sources. At the same time, Lambert and Stock (2001) define the most important sources of data for the common database, which are the order processing system, company records, industry data, and management data. Similarly, Moberg et al. (2002) further defined operational and strategic information as almost the same as Bowersox et al. (2002) characterization of logistics information utilisation in two major logistics processes:

2.4.1 Planning/Coordination

The overall purpose of planning/coordination is to identify required operational information and to facilitate supply chain integration through strategic objectives, capacity constraints, logistics requirements, inventory deployment, manufacturing requirements, procurement requirements, and forecasting.

2.4.2 Operations

Operational information is required in six related areas: order processing, order assignment, distribution operations, inventory management, transportation and shipping, and procurement. As a result, Bowersox *et al*. (2002) name four reasons why timely and accurate information has become more critical for effective logistics systems' design and operations:

- Customers perceive information about order status, product availability, delivery schedule, shipment tracking, and invoices as necessary elements of total customer service. With the goal of reducing total supply chain assets, managers realize that in formation can be used to reduce inventory and human resource requirements.
- Information increases flexibility with regard to how, when, and where resources may be utilized to gain strategic advantage.
- Enhanced information transfer and exchange capability utilizing the internet is changing between buyers and sellers and redefining the channel relationships.

2.5 Uses of Logistics Information Technology in Distribution

IT in supply chain has enabled the gathering, storing, and analysis of unprecedented amounts of data. It equally facilitates planning at all levels through data analysis and sharing, which enable planning to occur at the strategic, tactical, and operational levels. Similarly, IT gathers, integrates, and analyzes logistical data to streamline local and global supply chain. Every trading partner in the supply chain must be working from the same data shared in real time

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through a common hub. Sequentially passing information across each link of the supply chain perpetuates duplication of data, missed information, and time delays. In a related development, IT orchestrates the flow of demand supply, and cash in supply chain networks, with equal information flow material flow plus cash flow that include:

- Information flows replace or delay inventory flows whenever possible.
- Logistics and cost information aspects of each physical materials flow are performed electronically for better reliability and velocity, lower cost, and higher levels customer service.
- Electronic cash flows such as secure Electronic Fund Transfer (EFT) free up cash faster for reinvestment.

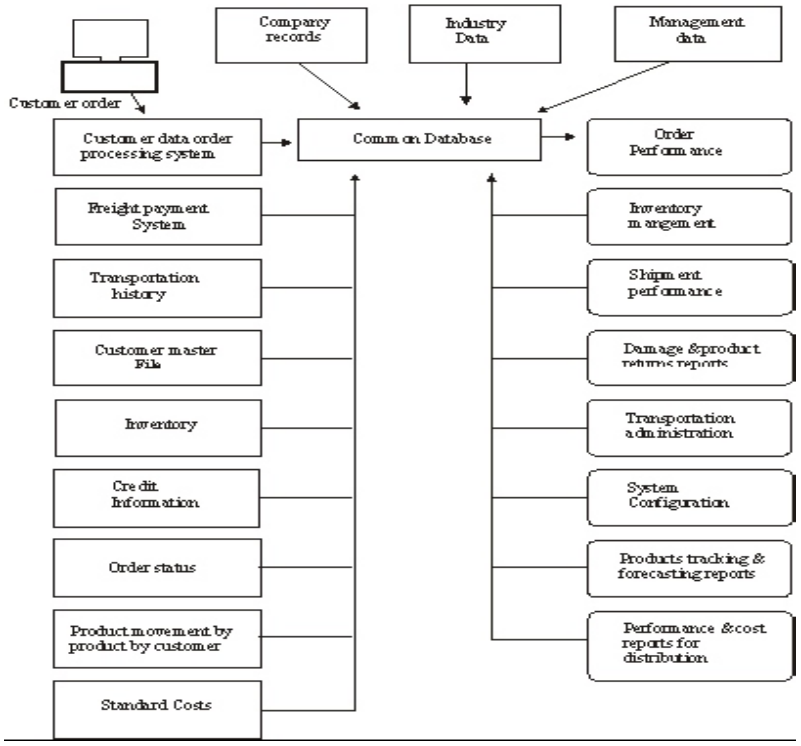

Fig 1: The Logistics Information Flow
Source: Lambert and Stock, (2001)

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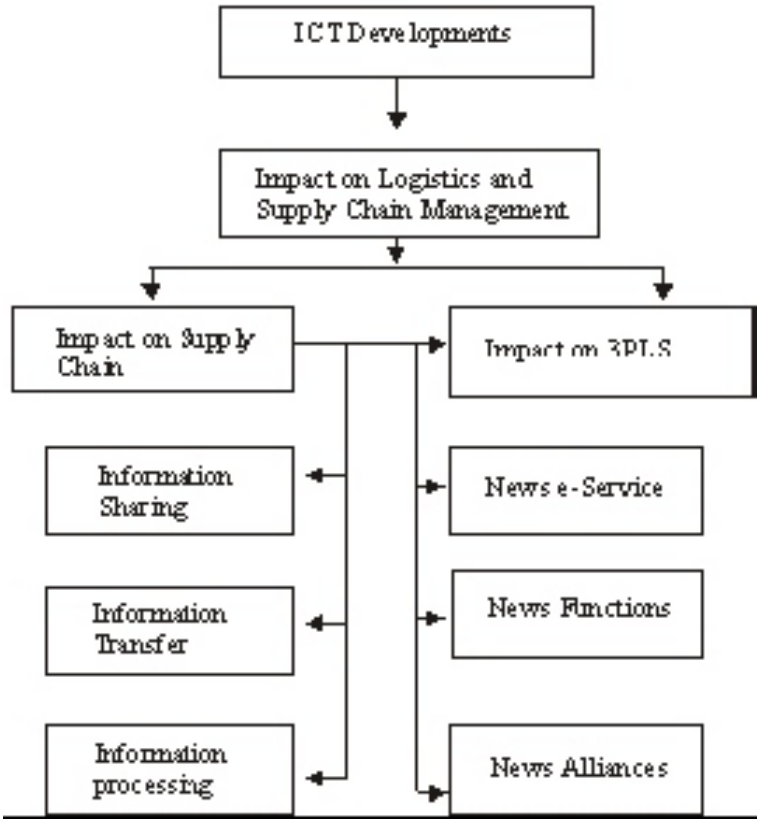

Fig. 2: Framework for analyzing the impact of ICT on logistics and SCM
Source: Lambert and Stock, (2001)

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 analysed 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 analysed 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 below:

2.5.1 Information Sharing

This is an essential prerequisite for securing information accessibility to all supply chain partners involved in logistics operations.

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The creation of distributed databases accelerates the development of relationships with other operators in the Supply Chain. In addition, the availability of consistent information improves decision-making process for operators. Data sharing has always been important in the transport and logistics of manufacturing companies. Access to and availability of information in intermodal transport, for instance, contribute to substantially reduced processes and thus time savings in freight transfer from one mode of transport to another and minimize errors in drawing up freight documentation, thereby increasing overall transport efficiency.

2.5.2 Information Transfer

This is probably the most relevant function in the SCM concept, because it takes place through several technologies ranging from the most recent e-business applications or extranet, Electronic Data Interchange (EDI) systems, to the most traditional communication technologies such as telephone, telex or fax. EDI is the most investigated technology in SCM literature. The widespread dissemination of the internet and e-business technologies allow to a large extent overcoming problems relating to systems and applications interoperability. This allows to extends the use of these technologies, including EDI, to smaller companies since internet application technologies require relatively low implementation costs and show a high flexibility in information transfer.

In physical distribution operation planning, ICT also plays a major role to the extent that the benefits obtained from the application of physical distribution logic depend almost entirely on a company's capability to establish electronic links with customers, suppliers and third party logistics (3PLT). ICT investments made by companies can range from platforms capable of satisfying the needs of single firms, such as Enterprise Resource Planning (ERP), to new applications that integrate all the stages of the supply chain and are able to support the entire planning process as the Enterprise Integration Application (EIA), or the Advanced Planning System (APS). Through these new systems, companies are able to combine and align their planning with that of other supply chain partners by covering the whole area of supply chain stage and thus making the planning process more efficient. 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 informediaries 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.

2.5.3 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 ES 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 described as a planning and

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communication system that affects all the resources of a company Boyle 2004). According to Boyle (2004), ERP is 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 and making tacit process knowledge explicit (transferring knowledge from an aging workforce into the ES).

III. Methodology

A case study design was used for this study. A purposive sampling techniques was used to select fifty (50) staff of Honeywell Flour Mill in Lagos, Nigeria. Data collected through questionnaire were coded and analysed through descriptive statistic of frequency counts, percentages and inferential statistics of Pearson Moment Correlation and Multiple Regression (R^2) analyses. Two hypotheses were tested at 0.05 levels of significance.

IV. Findings

This section presents the analysis of data collected and discussed the main findings of replies got from the staff of Honeywell Flour Mill in Lagos of Nigeria. The respondent consisted both senior level managers, middle level managers and junior level managers. Besides, fifty (50) questionnaires were administered and all were adequately and successfully filled and returned. Hence, the tests of the hypotheses were presented below along with the result of the major findings.

Hypothesis 1: *Relationship between Electronic Data Interchange, interactive telephone systems, e-commerce and the distribution of flour in Honeywell Flour Mill.*

Table 1: Coefficient Correlations of Joint Relationship between Electronic Data Interchange, interactive telephone systems, e-commerce and the distribution of flour in Honeywell Flour Mill.

	DoF	E-Com	ITS	EDI
DoF	1			
E-Com	.914***	1		
	.000			
ITS	.639***	.574***	1	
	.000	.000		
EDI	.385***	.278***	.211**	1
	.000	.000	.009	

*p<.05; **p<.01; *** p<.001

Note: EDI= Electronic Data Interchange, ITS = Interactive Telephone Systems, E-Com= E-Commerce, DoF = Distribution of Flour

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This result of table 1 measures the strength of the relationship that that exists between Electronic Data Interchange, interactive telephone systems, e-commerce and the distribution of flour. The bivariate correlation procedure focused to a two-tailed of statistical significance at three different levels of very highly significant (P<.001), highly significant(P<.01), and significant (P<.05).The result revealed that E-Com (r= .914; P(.000)<.05), ITS (r=.639; P(.000)<.05) and EDI (r=.385; P(.000)<.05) are positively correlated with Distribution of Flour. Finding also deduced that there is significant relationship between EDI, ITS and E-commerce.

Hypothesis 2: *Relative Joint Contribution of Electronic Data Interchange, interactive telephone systems and e-commerce on the distribution of flour in Honeywell Flour Mill.*

Table 2: Multiple Regressions of Respective Variables

Factors	β	T	P	R	Adj. R^2	F	P
Electronic Data Interchange	.841	4.969	.000				
Interactive Telephone Systems	.653	3.121	.000	**.935**	**.642**	**14.739**	**<.05**
E-Commerce	.962	5.841	.000				

Finding of the above Table 2 revealed that Electronic Data Interchange (β=.841; p(.000)<.05), Interactive Telephone Systems (β=.653; p(.000)<.05) and E-commerce (β=.962; p(.000)<.05) correlates significantly with distribution of flour. Furthermore, the coefficient determination of (R) is .935 which is positively correlated at 0.05 level of significant (R=.935; Adj. R^2= .642; $F_{(3,47)}$=14.739; p<.05). The finding revealed that logistics information systems (i.e. Electronic Data Interchange, Interactive Telephone Systems and E-commerce) jointly and positively contribute to the distribution of flour in Honeywell Flour Mill, Lagos Nigeria. Statistically, R^2 value of .642 signifies that 64 percent variance in logistics information systems are accounted for by all distribution of flour in Honeywell Flour Mill in Lagos.

V. Conclusion and Recommendations

This study has examined the effect of logistics information systems in the distribution of flour in Nigeria. This study was able to test for two hypotheses in which all were rejected. It was reveals from the study that, Electronic Data Interchange, Interactive Telephone System and E-Commerce have 94% significant effect on the distribution of flour in Honeywell Flour Mill. In conclusion, logistics information systems positively and significantly contribute to the distribution of flour in Honeywell Flour Mill. The study therefore recommended that Honeywell Flour Mill should upgrade their logistic information systems to computer-to-computer communication of business transactions and documents, as well adopt new technology such as, tracking-and-tracing systems (Barcode-scanning for packages and palettes), tracking vehicles with Global

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Positioning System (GPS), measuring vehicle performance with 'black boxes' (containing logistic data) and Automatic Equipment Identification (AEI) into their systems.

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