

Leveraging Supply Chain Performance through ICT Integration

Geraldine Nkechi Okeudo, Kingsley Chukwudi Kalu, Goodluck Tochukwu Njoku

Abstract— Globalization, outsourcing, customization, time to market and pricing pressure that define the present business environment require that organizations continue to invent and reinvent strategic business process for effective market positioning and competitiveness. The study is an effort to evaluate the effects and efficiency of ICT integration in supply chain process. Following a descriptive survey with questionnaires structured to meet the objectives of the research and a review of related literatures, the research sought to gain understanding on the significance of ICT supply chain integration. Descriptive and inferential statistics were employed in data analysis and test of research hypothesis. Study finding affirms the strategic role of ICT in supply chain efficiency and competitiveness, whilst requiring logistics and supply chain operators to seek ICT tools best suited to their operation and adopt same for optimal business efficiency and competitiveness

Index Terms— ICT, Logistics, supply Chain, Competitiveness

I. INTRODUCTION

Information and Communication Technology (ICT) and its attendant innovations as well as ever growing application resource tools is globally acknowledged as one of the main drivers of change, posing new strategic challenges in business and service provisions, enhancing organizational performance, and engendering social and economic changes[1].

The ICT revolution based on economic globalizations and intense competition impacting organizational value chain have birthed a new competitive environment as such organizations and managers must seek to adapt to thrive in their sectors as it impacts their value chain. The growing competitive environment requires that organizations increase value for their product and services through adaptation, increased personalization and customization, and quick response to customer's queries and demand. Managers need to look to technology adoptions as tools to better adapt to the ever dynamic and competitive environment [6-7]. As such, many organizations and significantly logistics and supplies have adopted the ICT systems and applications in their business operations to drive excellence, enhance and great new values for the business as well as expand the reach of the business.

The influence of ICT on the mobility of people and goods enabling change in social and organizational practices, engineering change in business dynamics and impacting significantly on the spatial nature of transport demand is well acknowledged by the academia. In logistics and supply chain, the increasing importance of ICT and e-business activities deployment is widely acknowledged by research. ICT resource tools and applications have become a significant dimension of logistics and supply chain process, providing a platform through its application for the creation of value for customers thus becoming a veritable tool for competitive advantage in logistics and supply chain operations. ICT gadgets such as computers, telephones, internet, communication networks and systems is widely employed in the logistics and supply chain process and has become the basis for competition, growth and success in the industry.

The supply chain comprises the flow of all information, products, materials, and funds between different stages of creating and selling a product to the end user [2]. A prime objective of the logistics system is ensuring that products gets to customers timely, in the right place and according to order; right quantity and quality and very importantly at a competitive cost [3-4]. Every stage in the supply chain process is information driven. ICT resource tools and application has thus become integral to the industry, making information available not only at the right time, but also in the right place, fulfilling the objectives of the supply chain process very efficiently. The supply chain adoption of Information Technology tools research affirms is vital for supply chain efforts to be expanded beyond the boundaries of the organization to integrate all stakeholders and to adopt an effective and efficient supply chain management. It is suggested that passing information to all businesses in the supply chains and procurement via ICT will improve performances [5]. The capabilities of ICT networks and systems enable organizations to expand beyond the boundaries of their business domains to compete in markets in other regions. ICT adoption through effective business integrations and seamless flow of information minimize operational error and business cost, optimizing profit. The usage of ICT research acknowledges is a veritable innovative tool to drive and ensure quality customer service for utmost business competitiveness. Today's customers are demand a greater involvement and the ordering and delivery process of the products and services they receive. The customer demands for faster product use, so that the availability of products is an increasingly important differentiating characteristic for the chain of supply. Customers increasingly demand enhanced product quality and order fulfillment

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process as well shorter lead times. An ICT application capability in this context is necessary for the supply chain to more and more flexible and reactive to anticipate, and to adapt to such changes. The supply chain given the spate of globalization that integrate the world market such that there are no limits to the marks a firm can play in requires a system to redefine and streamline its business operations end to end for market relevance.

It is against this backdrop that the study has become necessary to create awareness on the strategic role of ICT to organizational competitiveness whilst expecting that by it supply chain operators especially in developing countries where adoption is low would seek out tools best suited to them and apply same to create and drive competition. It is against this backdrop that the study has become necessary to create awareness on the strategic role of ICT to organizational competitiveness whilst expecting that by it supply chain operators especially in developing countries where adoption is low would seek out tools best suited to them and apply same to create and drive competition.

II. RESEARCH OBJECTIVES

The specific objectives of the study are to;

1. Examine the ICT supply chain task.
2. Propose a model for the analysis of the effects of ICT supply chain integration in the supply chain process
3. Evaluate the objectives and the significance of ICT supply chain integration to supply chain efficiency and competitiveness with respect the organizations under study

III. HYPOTHESIS

1. There is no significant difference for ICT supply chain integration and effective flow of information across supply chain network.
2. ICT supply chain integration has no significant difference for reducing requirement for inventory and human resource.
3. There exist no significant difference for ICT supply chain integration and better planning and tactical decisions making.
4. Supply chain adoption of IT systems and applications has no significant difference for effective and timely fulfilment of customer order.

IV. LITERATURE

ICT is an umbrella term that encompasses a wide array of systems, devices and services used for data processing (the information side of ICT) as well as telecommunications equipment and services for data transmission and communication (the communication side). It supports activities involving information such as gathering, passing, storing and presenting data as well as collaboration and communication [8]. ICT at the early stage of inception, IT systems and applications are seen as mere labor save and cost cutting tools. Today however, it has transcended these elementary functions to become organizational core competence and a veritable tool to leverage productivity, innovation and competitiveness [9].

ICT would continue to change the way businesses operate in this era of globalization by changing business structures and increasing competition, creating competitive advantage for businesses and by changing business operations [30]. IT application tools such as Electronic Data Exchange (EDI), Radio Frequency Identification (RFID), Bar Code, Electronic Commerce, Decision Support system, Enterprises Resource Planning (ERP) package are critical to optimizing the decisions of the supply chain network flow for organizational competitiveness through quality services, cost, inventory and electronic risk (e-risk) reduction [10].

A. ICT Supply Chain Synergy

The supply chain as defined by the Council of Supply Chain Management Professionals relates to a series of activities ranging from manufacturing to retailing defining a business process linking vendors, service providers and customers together. It comprises the flow of information, products, materials, and funds between different stages of creating and selling a product to the end user. From the operational management perspective, the supply chain portrays a chain of activities including service and goods creation, manufacturing, and transportation to point of sale, and selling it [11]. Essentially, the purpose of the supply chain is serving the end customers and the extent to which the supply chain is able to service this purpose defines the market competitiveness [12]. The supply chain is driven on the wheels of logistics; the vehicle that sees to the movement of materials from manufacturing to delivery. It is the goal of logistics to ensure that the right goods are delivered to the end customers and so in the right quantity, place, and time, and at a competitive price [13].

ICT solutions in companies' logistics and supply chain are very important for business growth and success. They are key to winning and keeping loyal customers with company [6]. ICT systems and applications under a customized supply chain context facilitates the management of interconnecting data flows among the chain actors, substantially increasing speed of data identification, data gathering processing, analysis and transmission, with high level of accuracy and reliability [14] [16]. ICT resource tools are vital for effective integration and efficient coordination of all logistics activities within and without the boundaries of the organization, including customers, suppliers and agents ensuring a more effective control of time, cost, and service quality [14]-[15].

The change in the importance of ICT in supply chain process according to research is driven by three significant factors;

1. The need to meet and surpass customer expectations.
2. Reduction of the requirement for inventory and human resource requirement to competitive level.
3. The strategic role of information in planning, decision making and resource deployment.

B. Dimensions of ICT Supply Chain Integration

ICT supply chain integration is encompassing, involving a wide range of dimensions such as processes, information, organizations and systems integration. Generally, it could be categorized into two; internal and external integration. Internal integration aims to link all business functions within the boundaries of the organization such as production, logistics, inventory, sales and accounts to a seamless process pursuing operational efficiency, quality service and customer satisfaction. External integration focuses on the relationship between the firm and the stake holders; customers, and suppliers as well as agents and service providers with a view to ensuring effective optimization of business process, product and service flow between companies [17]-[19].

Process integration is encompassing involving the relationship between the upstream and downstream aspects of the business and establishing linkages between the internal business functions of the firm and that of other chain participants ensuring effective collaboration along the value chain. Process integration ensures seamless flow of deliveries between suppliers, manufacturers and customers as well as collaborations between buyers and suppliers. IT systems capabilities such as data integrity, real time availability, visibility and processing capability of information and standardization of business process facilitate effectively seamless matching of supply and demand between supply chain members, creating an excellent backdrop for embarking on integration with external partners in the supply chain [20].

Information integration involves the sharing of information and knowledge across the supply chain including for instance demand information, forecast and stock availability. Information is considered to be the glue that holds organizations together and can be used to integrate process activities both within and across multiple processes. It serves as the connections between various stages of the supply chain, allowing effective coordination, optimization of supply chain profitability, and adequate execution of day to day operation of each stage of supply chain [21]-[23]

C. ICT Supply Chain Task

IT capabilities are vital for fully integrated supply chain management solutions incorporating supply chain configuration, demand forecast and planning, production schedule, logistics and inventory management systems of an organization [23]. It is important to effective integration of the functionalities of the value chain participants and stakeholders ranging from suppliers, manufacturers, distributors and end customers with a view to satisfying product quality and quantity. ICT network functionality is critical to effective management of the supply chain as it enables timely process and effective sharing of information as well as efficient execution of supply chain management transaction including coordination of internal and external collaborations[18] [24]-[25]. ICT applications are considered to have a positive impact on both the internal process of an

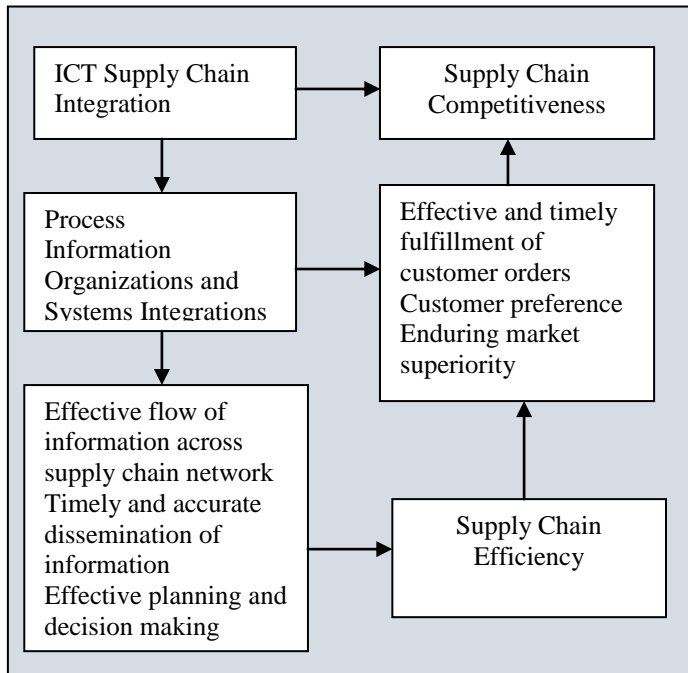
organization and collaboration with partners including suppliers, agents and service providers [26] [27]. ICT supply chain network architecture seamlessly integrate all the stakeholders in product distributions ensuring electronic exchange of transport documentations; bill of lading, product certificate, air waybills, invoices, order and payment instructions.

ICT is a key business driver and a competitive strategy, impacting greatly on the responsiveness and efficiency of the supply chain. IT is vital to the success of value chain of companies as it enables seamless and efficient coordination of the supply chain activities as well as timely and accurate dissemination of information which is now more critical than ever. Organizations can seamlessly gather information about the market situation and quickly react to envisioned changes. This in and of itself is a competitive strategy and strength improving organizational efficiency and market position [28]. IT applications are critical to enhancing the agility of the supply chain to power up operations, reduce cycle time, achieve greater efficiency, respond to customer's queries and deliver products to the customers timely.

IT solutions capabilities enable the automation of physical flow of materials and goods as well as information among the value chain participants improving supply chain efficiency and competitiveness. Automated process executed supply chain system limit transaction errors, provides accurate and timely data, supporting supply chain management decisions and planning [29]. IT network functionality streamline the supply chain, increase customer service, reduce costs, and contribute significantly to the performance of the supply chain.

V. RESEARCH MODEL

Following the review of literatures, we propose a model for the analysis of the effects of ICT adoption on the performance of the supply chain. The purpose of the model is to provide explicit insights to the intricate relation between ICT solution and supply chain competitiveness. Embodying the scope and analytical frame work of the study, the model serves to guide empirical investigations on the effects ICT supply chain integration on the performance of the supply chain. ICT integration in logistics and supply chain the model portray is key to the operational effectiveness and efficiency of the supply value chain, leading to organizational competitiveness through enhanced performance of the value chain.



Model for the Analysis of the Effects ICT Supply Chain Integration on Supply Chain Performance

VI. RESEARCH METHODOLOGY

The research followed a descriptive survey relying on review of related literatures and survey questionnaires structured to meet the objectives of the research. The study organizations are Zinox Technologies, Technology Distributions (TD Africa) and Konga.com. Zinox Technologies is a Nigerian indigenous manufacturer and distributor of Zinox computers and accessories. TD Africa in partnership with several Original Equipment Manufacturers (OEM), is an accredited distributor of computer systems and accessories, network equipment and communication devices, consumer electronics and much range of consumer goods. TD is acknowledged as the number one in ICT distributions in Sub-Saharan Africa. Konga.com is an online and offline retailing store. The organizations were chosen following the volume of their sales and distribution networks all over the country adopting the capabilities ICT system and application tools.

The study sample was drawn from the executive staff of the case study organizations. Only the staff that have worked consecutively with the respective study organizations consecutively for 3 years and more were considered for the research. It is expected that this group by virtue of their executive functions and years of service have gotten wider knowledge of the functionalities and operations of the companies as to provide insightful and unbiased response to the survey questions. The the survey staff were drawn randomly from a staff list as provided by the Human Resource officer of the case study companies. 50 each were from the staff list of each study company making a total of 150 questionnaires for the research. The research resorted to questionnaires for the survey as there are no available secondary data to capturing how ICT adoption impacts the operations of the company. No company in Nigeria for the time being has developed the capacity and systems to capture such data. The study questionnaires were distributed through

one on one contact with the respondent. This enabled the researcher put a face with the respondents to educate them on the importance of the research and guide in filling of the survey questionnaire. The respondents on schedule were allowed a week gap to fill up the survey questionnaires after which the researcher returned to collect it.

The survey questionnaires were divided into two stages. The first is for the description of the respondents and the second is for the variables relating to the objectives of the research. A sum of 143 questionnaires for which 137 is valid for the research was returned and employed in the study. Table 1 below presents the questionnaire analysis.

Table 1: Questionnaire Analysis

Distributed	Returned	Invalid	Valid
150	143	6	137

Source: Author's Field Survey.

VII. DATA ANALYSIS AND PRESENTATION

A. Objectives for ICT Supply Chain Integration

The study aims to determine the objectives of ICT solution adoption in the supply chain process. Following a review of related literatures, indicative variables describing perceived objectives for ICT supply chain integration were put forth to the respondents on a five point likert scale ranged from 1 (strongly disagree) and 5 (strongly agree) to elicit their level of agreement and disagreement to them.

Descriptive statistics in table 1 shows the mean scores and standard deviation for each indicative variable relating to the objectives for the adoption of ICT solutions in supply chain of the study organizations.

Table 1. Descriptive Statistics for the objectives of ICT supply chain integration

Indicative Variable	N	Mean	Std. Deviation	Std. Error Mean
Effective customer service	137	4.3358	.82495	.07048
Cost reductions	137	3.6569	.95823	.08187
Better planning and tactical decision making	137	4.3650	.89011	.07605
Operational competitiveness	137	4.3723	.79527	.06794

The mean score 3.6569 represent rating between “neutral” and “agree” while 4.3358, 4.3650, and 4.3723 represent rating between “agree” and “strongly agree”. The higher mean scores are indications that the indicative variables are objectives for ICT adoption in the supply and sales operation the study companies. That is to say the research organizations principally adopt ICT solutions for enhanced customer service, better planning and tactical decisions, and operational competitiveness. The indicative variable; cost reductions with a mean score 3.6569 representing rating between “neutral” and “agree” shows that though ICT may aid cost reductions, it is not however, principal to the

objectives ICT supply chain adoptions in the study companies. Numerous researches acknowledge that ICT adoptions in the supply chain needful for cost reductions but this has got no empirical backings yet. ICT solution and application tool in and of itself is a cost.

			tailed)		Difference	
					Lower	Upper
V ₁	18.348	136	.000	1.20438	1.0746	1.3342
V ₂	4.417	136	.000	1.62774	.8990	2.3565
V ₃	13.434	136	.000	1.09489	.9337	1.2561
V ₄	16.981	136	.000	1.21168	1.0706	1.3528

B. Significance of ICT supply chain integration to supply chain efficiency and competitiveness

Table 3: Descriptive statistics for the significance of ICT integration in supply chain efficiency

Indicative Variables	N	Mean	Std. Deviation	Std. Error Mean
V ₁	137	4.2044	.76829	.06564
V ₂	137	4.6277	4.31313	.36850
V ₃	137	4.0949	.95396	.08150
V ₄	137	4.2117	.83517	.07135

The study sought to evaluate the significance of ICT supply chain integration to supply chain efficiency and competitiveness. Efficiency herein is defined by the competitiveness of the supply chain. That is to say, how well the supply chain is positioned for customer preference and enduring market dominance. This is based on the research model as proposed.

Following a five point likert scale ranged from 1 (strongly disagree) to 5 (strongly agree), the study sought to elicit the response of respondents to the indicative variable describing the perceived significance of ICT integration to supply chain efficiency. Descriptive statistics as tabulated in table 3 shows the mean scores and standard deviation for each indicative variable; V₁ (effective flow of information across supply chain network), V₂ (timely and accurate dissemination of information), V₃ (effective planning and decision making), and V₄ (effective and timely fulfillment of customer order)

The mean scores represent ratings between 4 “agree” to 5 “strongly agree”. The higher mean scores “4.2044, 4.6277, 4.0949, 4.2117”, are an indication that the variables are significances of ICT adoption to supply chain efficiency.

Furthermore, one sample t-test in table 4 below was carried out to identify the significance of ICT to supply chain efficiency. In the t-test, the mean value of the Likert scale (1-5), 3 was used as the test value to compare the mean of the sample. The t-test result shows a significant difference between the sample mean and the test value. Low P value (< 0.05) for all variables indicate high significant difference between sample mean and test value. Also, positive upper and lower confidence interval is an indication of the fact that the sample mean is greater than 3. This leads to reject the null hypothesis and accept the indicative variables, effective flow of information, timely and accurate dissemination of information, effective planning and decision making, as well as timely delivery of customer orders are significant to the efficiency and competitiveness of the supply chain.

Table 4: One-Sample t-test for the Significance of ICT integration in supply chain efficiency

Test Value = 3				
sT	Df	Sig. (2-	Mean Difference	95% Confidence Interval of the

VIII.CONCLUSION

The advent of ICT have seen many application innovations evolved to find practical relevance and well integrated in the logistics and supply chain process. The computer system and applications, mobile phones, the internet and IT solutions are widely embraced in the supply chain process of companies. The study examined the objectives and significance of the drive for ICT adoptions in the supply chain process identifying the ICT supply chain tasks and a model proposed as a basis for empirical analysis of the effects of ICT adoptions on the supply chain performance. Study findings show that the objectives of ICT supply chain integration aim to enhance strategic planning and decision making process, ensure quality customer service, cost reductions and operational competitiveness. This is achieved through the capabilities of ICT supply chain integration enabling effective flow, timely and accurate dissemination of information, prompt response to customers queries and shorter order processing and delivery lead times as well as seamless, quick and error free access to large array of data for strategic planning and decisions.

ICT systems and application the study affirms is integral to the supply chain operational efficiency and competitiveness. Operational efficiency hinge on timely and accurate flow of information leading to a responsive, agile and dynamic supply chain, swiftly adapting to market changes through effective planning and strategic decisions, thereby keeping ahead of competition and possibly create new competitive strategies. Supply chain competitiveness as well derives from quality customer service. The increasing demand of the today customer as to order placement and delivery is well acknowledged by literatures. The customer requires swift response to queries and clear visibility to the shipment process. When customer needs are met and even exceeded they pitch their tent with the supplier and also refer other customers. ICT system and application in the supply chain ensure prompt response to customer query, timely process of customer orders and delivery within the shortest lead time. The tracking capabilities of the ICT systems enabling customers visibility to other shipment process is a key to quality customer service. Organizations could leverage ICT supply chain capabilities to enhance efficiency, create competitive advantage and boost market position. Supply chain operators are to seek ICT tools best suited to their operation and adopt same for optimal business performance.

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