

INFORMATION AND COMMUNICATION TECHNOLOGY TOOLS AND SUPPLY CHAIN PERFORMANCE OF NIGERIAN MANUFACTURING COMPANIES

Efa Imoke¹ Effiom Effiom Inameti²

¹Department of Marketing, University of Calabar, Cross River State, Nigeria

²Department of Entrepreneurship and Marketing, Federal University Otuoke,
Bayelsa State, Nigeria

Emails: efaimoke1@gmail.com¹, inametiee@fuotuoike.edu.ng²

All correspondence to: efaimoke1@gmail.com

ABSTRACT

This study looked at how manufacturing companies' supply chains performed in relation to information and communication technology. The major objective of this study was to examine the impact of ICT on supply chain performance of manufacturing firms in Cross River State, Nigeria. Survey and descriptive research designs were used. The population of the study consisted of 1,129 workforce. A sample size of 297 was derived for the study. Purposive sampling technique was adopted to choose the subjects. Multiple regression was used to statistically analyze the data. The findings showed that radio frequency identification, barcode scanners, and electronic data interchange had a major impact on manufacturing companies' supply chain performance. Among other things. The study concluded that, manufacturing companies' supply chains are impacted by barcode scanners, RFID, and EDI. Because of the clear impact on performance, the study suggested among other things, that manufacturing companies should use ICT tools like barcode scanners, radio frequency identification, and electronic data interchange in their supply chain operations.

Key words: Radio Frequency Identification, Barcode Scanning, Electronic Data Interchange, Supply Chain, Performance

CITE AS: Imoke, E. & Inameti, E.E. (2025). Information and communication technology tools and supply chain performance of Nigerian manufacturing companies, *Tansian University Journal of Arts, Management & Social Sciences*, 9(1), 18 - 34.

INTRODUCTION

Information and communication technology helps supply chain operations to improve the efficacy and efficiency of a company's processes (Cohen et al., 2002). To increase supply chain efficiency and operation, ICT tools help with task execution, distribution, and decision-making (Jack et al., 2006). Additionally, ICT tools increase the transparency of business processes for stakeholders and business partners, which in turn boosts their trust (Bharadwaj, 2000). The majority of businesses want to use ICT tools to streamline production, supply chain operations, and customer feedback in order to increase market share, cut expenses, and boost profits. By definition, a supply chain includes all of the operations related to the transportation, conversion, and distribution of raw materials to consumers, as well as the flow of critical information and financial transactions (Effy, et al, 2008). Performance measurement is the process of assessing the efficacy and efficiency of activities, according to

Neely, Gregory, et al, (2005). A company's ability to produce and market knowledge wisely determines how well it performs (Sampson, 2017). Businesses' performance has a significant impact on stakeholders, business partners, and society at large. Return on investment is crucial for investors and depositors, and a successful company will undoubtedly generate a high turnover for both partners and depositors (Mirza, 2013). A company must be ready to expand its capacity in order to boost performance (Flynn et al., 2010).

According to the Global Supply Chain Forum (1998), supply chain management (SCM) is the integration of essential business operations from the supplier to the final consumer, guaranteeing the availability of goods and services as well as information for shareholders and customers. Aiming to provide services to customers at a lower cost, the combined strategy of planning, monitoring, and controlling the flows of goods from vendors to customers also fosters the development of friendly relationships among distribution channel members to improve timely information exchange and the organization of business functions. Lyons (1998) proposed that the essential functions of SC can be broken down into eight dimensions: warehousing, channel selection and management, physical distribution procurement, inventory management, demand forecasting, and supplier management. When it comes to making decisions in the supply chain network for improved competitive advantage, effectiveness, efficiency, quality service delivery, inventory control, cost, and even risk minimization, the exponential growth in ICT application is actually helping and playing a crucial role. Information technology is also necessary for an organization to efficiently share information both inside and outside the organization. With the use of technologies like radio frequency identification (RFID), electronic data interchange (EDI), barcode scanners (BS), decision support systems, global positioning systems (GPS), enterprise resource planning (ERP) packages, and more, businesses are quickly embracing virtual supply chains.

ICT is essential to supply chain performance in the following ways: (1) It facilitates the exchange of information among the company, its stakeholders, business partners, and clients. (2) It facilitates the dissemination of real-time information throughout the supply chain, such as product planning, scheduling, inventory levels, and delivery status, thereby enabling businesses to take charge of their supply chain management. (3) It also encourages firms and trading partners to coordinate their scheduling and forecasting processes, allowing for stronger inter-organizational relationships. Thus, challenges typically faced in supply chain operations, which are frequently postponed due to time and distance, can be reduced (Paulraj et al. 2017).

Problem Statement

One of the most important sectors of the Nigerian economy is the manufacturing sector. In service delivery, manufacturing companies' performance continues to be a major issue. The need for efficient and high-quality service delivery has been brought on by the demand for quality services from both individuals and businesses. Using ICT in the supply chain is essential to achieving high-quality service delivery. It is clear that businesses in the twenty-first century that do not use information and communication technology will eventually fail in this fiercely competitive environment. The ease of use of most ICT applications and their relative usefulness to improve the skills and expertise of owners/managers to improve their businesses are being exploited by SMEs due to the current economic situation brought on by the Covid-19 pandemic. In order to reduce costs and enhance productivity and service delivery, the majority of manufacturing companies now concentrate on monitoring their vehicles and employees, including drivers, assets, and even sales agents (Zhirong et al., 2010). This study's primary goal was to investigate how ICT affects manufacturing companies' supply chains in Cross River State.

Objectives of the study

The major objective of this study was to examine the influence of ICT on supply chain performance of manufacturing firms in Cross River State, Nigeria. The specific objectives include:

1. To examine the impact of barcode scanner (BCS) on supply chain performance of manufacturing firms in CRS.
2. To determine the impact of radio frequency identification (RFI) on supply chain performance of manufacturing firms in CRS'
3. To assess the impact of electronic data interchange (EDI) on supply chain performance of manufacturing firms in CRS.

Research Questions

The following research questions guided this study:

1. To what extent does barcode scanner (BCS) impact supply chain performance of manufacturing firms in CRS?
2. To what extent does radio frequency identification (RFI) impact supply chain performance of manufacturing firms in CRS?

3. To what extent does electronic data interchange (EDI) impact supply chain performance of manufacturing firms in CRS?

Research Hypotheses

The following research hypotheses were postulated in null form for this study

- H₀₁: Barcode scanner (BCS) does not significantly impact supply chain performance of manufacturing firms in CRS
- H₀₂: Radio frequency identification (RFI) does not significantly impact supply chain performance of manufacturing firms in CRS.
- H₀₃: Electronic data interchange (EDI) does not significantly impact supply chain performance of manufacturing firms in CRS.

LITERATURE REVIEW

Theoretical Underpinning

Tornatzky and Fleischer developed the 1990 Technology-Organization-Environment model. TOE models how technology affects organizations and how the ecological framework affects a firm's adoption and use of technology (Drazin, 1991). An organization's current internal and external automation, as well as new technologies that are available on the market but have not yet been implemented by the company, are all described by the technological framework. The firm's size, human resources, and organogram are all described by the organizational framework. However, the term "environmental framework" refers to elements like the environment, supply chain participants, and competitors that are outside the firm's control. In previous studies on technology adoption, firms have employed the Technology-Organization-Environment model, which provides a systematic arrangement of inducing factors (Liu et al., 2011). In addition, Songer et al. (2001) added a fourth dimension to the model called economic factors, which implies that if a technology is reasonably priced, an organization might think about implementing it. A firm's decision to adopt a very expensive technology would be directly impacted by the expense of maintaining it and the potential risks involved. In light of the aforementioned, the fourth variable was incorporated into the manufacturing firm model in this study.

Technology Acceptance Model

Davis (1989) proposed the Technology Acceptance Model (TAM), which is based on perceived usefulness and ease of use and is used to explain how information systems are used.

It is one of the most popular and modest theoretical models of technology use and user acceptance; it is self-explanatory and very easy to understand, which is why it is considered to be one of the most popular models across various disciplines. According to Davis et al. (1989), adoption of the model is the use of hardware and software technology in a firm to increase productivity, processing speed, competitive advantage, and guarantee timely information availability. TAM evaluates how well-received new technologies are by users. Only the use of information and communication technology is covered, making it more focused. TAM is not very useful for exploration. It is not able to explain or forecast phenomena. It is insignificant and has no real-world application. TAM gives the impression that knowledge accumulation is progressing. The likelihood of perceived ease of use serving as a foundation for attitude and intention to use is lower. Additionally, the model is not objective, accurate, or applicable enough to be a well-established theory for the environment of information systems. Davis (1989) asserts that PU and PEOU affect how customers behave when it comes to utilizing and accepting information and communication technology in a business. The degree to which customers believe that using information and communication technology will raise expectations is known as PU. PEOU measures how much consumers think it would be easier and less stressful to use information and communication technology. The TAM has been extensively employed in various studies and has demonstrated its dependability and efficacy in elucidating the adoption and utilization of information and communication technologies (Venkatesh, et al, 2000).

Conceptual Framework

Supply Chain

A supply chain is a system or network that includes manufacturers, distributors, wholesalers, retailers, suppliers, and customers. It is a connection or exchange between supply chain participants. In order to meet customer needs, the supply chain also encompasses all of the activities involved in researching those needs, acquiring raw materials, turning them into products, and providing transportation and services (Nickels, et al, 1997). Gbede, 2005 Relationships between channel members are primarily focused on increasing process efficiency and reducing costs to improve the quality of services provided to end users. It entails organizing and planning every task, including sourcing, conversion, purchasing, logistics, inventory, and other related tasks. In essence, it also entails collaboration and teamwork with channel participants, including customers, middlemen, and vendors.

Barcode Scanner

A barcode is a parallel-configured graphical field with wide and narrow gaps and bars between bars that represents an information field that has been coded. It is a label that can be read by an electronic device and contains information about an item or items, including the item's type, origin, destination, and billing details. According to Hensher, et al, (2001), it can be affixed to objects, products, or containers of goods. Data can be stored in optical or magnetic form as part of a communication structure using barcodes, which are made up of width lines oriented vertically and horizontally. Businesses utilize it in the supply chain to automate product tracking and tracing at every phase of the manufacturing and delivery process. Additionally, because it is machine-readable and in coded format, it provides timely and accurate information that is essential to removing errors (Ellram et al., 1999). The use of barcodes and scanners completely eliminates theft, which happens frequently in businesses that manufacture consumer goods and leads to serious inefficiencies like subpar customer service, excessive inventory, a misguided capacity plan, a porous production plan, a lack of transportation, and lost revenue. The European Article Number, or EAN, was created in 1976 to meet the needs of the grocery industry. The United States' Universal Product Code (UPC) was improved upon by the EAN code. The manufacturing industry makes extensive use of the barcode system due to its low cost and high convenience for product identification.

Rajiv (2019) lists the following effects of barcode systems on logistics and supply chain operations.

- a. **Procurement function:** Vendor-developed components are assigned barcodes that contain information like the item's name, manufacturing date, batch number, serial number, order number, and more. The barcode's information aids in product identification and tracking. Products are typically scanned using a handheld scanner in a typical warehouse after being received from a conveyor. The information decoded from the product's scan is instantly sent to the central computer, where it is used for real-time inventory updates.
- b. **Processing function:** Based on the estimated date of arrival, the barcode information aids in storing and identifying the product at the order processing point. This procedure uses the first-in, first-out principle to make material storage, retrieval, and dispatch very simple.
- c. **Production function:** Barcoding every item makes it very simple to identify and track semi-finished and finished products.

d. **Distribution function:** Barcodes at the distribution point also greatly aid in the tracking and identification of the final products, even as they are being transported to the final consumers.

e. Radio Frequency Identification

RFID technology uses tags that can send and receive radio signals in the form of unique serial numbers. The tags can also be used on scanners that receive the data they transfer and send it to a remote server system for additional analysis and evaluation. Auto ID is the foundation of both barcode and radio frequency identification technology. In barcode, a barcode readable device uses an optical laser or imaging system to scan the printed label, whereas in RFID, the scanning device uses radio frequency signals to actually scan a tag. RFID technology can improve supply chain operations in a number of ways, including visibility into customer needs, accurate and trustworthy order forecasting, efficient business processes, lower operating costs, increased productivity, detection of counterfeit goods, theft prediction, and improved tracking (Attaran, 2007).

According to Coronado et al. (2004), radio frequency identification includes verification and authentication. It also improves forecasting and planning skills and lowers channel volume (D'Avanzo et al., 2004). RFID is also used by organizations to manage their warehouses (Attaran, 2007). In fact, Wal-Mart set a deadline for vendors to begin utilizing RFID tags in their operations (Coronado et al., 2004). RFID makes it possible for vendors to efficiently handle product recalls, returns of defective goods, and defect products (Sabbaghi, et al, 2008). According to Jedermann et al. (2009), RFID adoption by businesses is actually growing quickly in supply chain networks these days.

RFID technology can also be used in supply chain and logistics operations. The majority of businesses now attach RFID tag transponders as a result of this development. Some transponders resemble labels, plastic coins, or smart cards. They must be scanned using an RFID scanner, which can be installed at the loading location. Using the data stored on the transponders as well as additional data like temperature, weight, and construction date, this scanner is able to identify packages. Only when the system is set up to use barcodes and RFID readers can RFID be useful in the supply chain (Sabbaghi et al., 2008). Due to its importance in the supply chain, RFID is one of the newest security technologies utilized by the majority of organizations. Because RFID tags are unique and genuine, a company can prevent item duplication by using them. Additionally, it significantly reduces supply chain fraud.

Electronic Data Interchange

First proposed in 1970, EDI gained popularity in 1980. Organizations have used EDI extensively in their supply chains to improve information sharing and streamline transactions. The exchange of structured data between computers for the purpose of automating tasks is known as electronic data interchange, or EDI. Members of the supply chain exchange critical information about their business operations via EDI. These kinds of friendly relationships are typically formed between businesses that have excellent and friendly long-term business relationships. For example, some distributors might choose to give their vendor specific information directly, which would cause the warehouse to automatically restock sold items. Building a strong sales pattern that can support the demand forecasting process is the result of developing such a friendly relationship with a trading partner. EDI offers many advantages since it eliminates the need for manual information gathering. For example, it facilitates the timely transfer of product, price, and sales information. Additionally, when required and on schedule, EDI can be used to create bills of lading, shipping information, invoices, and dispatch confirmations (Rushton et al., 2000).

One of the earliest significant technological advances that allowed businesses to connect commercially was electronic data interchange. The supply chain participants can process data exchanged via EDI without any human intervention (Sanchez, et al, 2003). EDI message formats ANSI X.12 and EDIFACT are frequently used. Mail, fax, and even courier have been replaced by EDI. In order to share important information about inventory control, accounting, order processing, improved customer service, transportation, production, cost, and competitive advantage within the supply chain network, it was introduced to cut down on paperwork (Garcia-Dastugue, et al, 2007).

Close relationships have been formed between suppliers and customers as a result of the creation of electronic data interchange connections with suppliers (Puschmann, et al, 2005). It is used to send documents via a third-party "network" that either directly or indirectly connects the computers of two organizations (Reynolds, 2001). In the supply chain, EDI is currently the most widely used connectivity method. Additionally, EDI improves order transmission and entry speed and accuracy (Lambert et al., 1998). Ross (2003) defines EDI as an extranet system that uses a set of information transfer formats that have been jointly developed and implemented. These formats are typically applied through a network called private value-added. Two common forms of EDI data transfer exist. Computer-to-computer and Third-Party Linkage are two methods of EDI data transfer. Transferring documents from

company A (the vendor) to company B (the trading partner) is made possible by computer-to-computer. Sales orders and payments may be included in the documents, which immediately update the databases of both parties.

The following are the most commonly acknowledged benefits of EDI, according to Greenstein and Feinman (2000):

1. Shortening the time it takes to place an order until the vendor actually delivers it.
2. Lowers the likelihood of data entry errors
3. Cuts expenses.
4. Speeds up customer information processing and restocking.
5. Improving networking and communication between supply chain participants.
6. Quickening the flow of information

Although EDI can help the supply chain, there are drawbacks as well, such as the fact that it is expensive and time-consuming, particularly when decoding. Additionally, organizations must agree to use a standard format. Despite the fact that EDI and the Internet both facilitate communication about logistics-related tasks, their applications differ slightly. When conducting non-monetary activities like placing purchase orders, marketing, or customer support, the Internet is frequently utilized. Businesses typically use EDI instead of the Internet for financial transactions like fund transfers, accounts payable, and billing (Reynolds, 2001). This is primarily due to EDI's standardized formats and relative security. Financial transactions involving several parties and financial institutions are better suited for EDI. Product handling, inventory control, order processing, scheduling, and distribution routing have all been aided by information technology advancements like POS readers, identical product codes, and EDI (Kotler, 2003). Businesses have been able to decrease uncertainty through the use of sophisticated barcodes, RF tags, EDI, etc. (Coyle et al., 2003).

Performance

In the context of an organization, the term "business performance" has various meanings. Operational performance, brand performance, market performance, research performance, and organizational performance (both financial and non-financial) are a few examples. Numerous research streams exist in this field, and studies examining the impact of service quality on performance must concentrate on a particular performance context. There is a wealth of literature on performance measurement using various methods, the most popular of which is the Balanced Scorecard approach. Once more, performance can be measured both

qualitatively and quantitatively, as well as at the organizational and employee levels. The three primary components of financial measures—profit margin, return on assets, and return on equity—are the most often utilized performance metrics at the organizational level of analysis. Financial reports, employee performance tracking, customer satisfaction, the health and safety environment rating, and the general effectiveness of equipment are just a few of the many uses for performance indicators. Proper identification of performance indicators can help with benchmarking, resource allocation and control, improving employee performance, and ultimately supporting the overall goals of the business (Inameti, 2022; Kumar, et al, 2009).

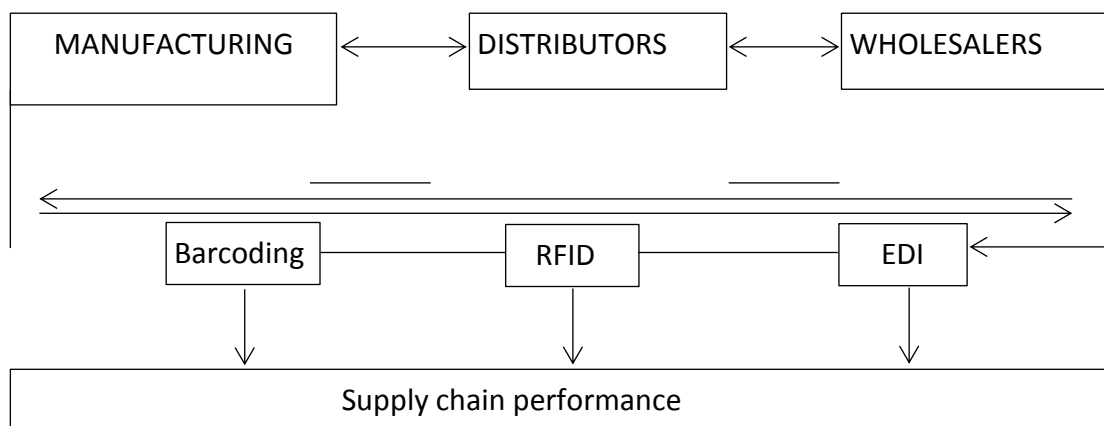


Figure 1

Conceptual ICT and supply chain model

Source: Adapted from: Source: Coyle, J. J., Bardi, E. J., & Langley, Jr., C. J. (2003). *The Management of Business Logistics: A Supply Chain Perspective*, 7th Edition, South-Western/Thomson Learning, Mason, Ohio.

Empirical review

Kareem (2023) examined Supply Chain Information Technology (SCIT) and Organizational performance: Evidence from Nigerian Manufacturing Industry. This study examines the relationship between the manufacturing sector's performance and the aspects of supply chain information technology (SCIT), with a particular focus on a few Nigerian manufacturing businesses. To reach a sample size of 100 respondents, the study used a targeted sampling technique to choose 20 respondents from each of the five manufacturing companies' departments of procurement and logistics. A structured questionnaire was used to gather information from the respondents, and path analysis was used to examine the information gathered. The results show that there is a positive and significant relationship between

organizational performance and the SCIT dimensions—ERP, CRM, EDI, and AAS. This correlation is seen in terms of better knowledge of consumer preferences, needs, and behaviors, more accurate data, and strategic decision-making. Efficiency of order processing. We can conclude that the manufacturing sector will experience improved decision-making, increased supply chain transparency, and operational efficiency as a result of SCIT implementation. This makes it possible for managers to proactively handle difficulties, maximize available resources, and promote supply chain performance enhancements.

Research Gap

Numerous studies extensively examine the beneficial effects of "ICT adoption" or "SCIT" (Supply Chain Information Technology) on organizational performance, efficiency, decision-making, and collaboration within Nigerian manufacturing, including enhancements in profit, customer satisfaction, and sales volume. Some make reference to particular tools such as EDI, CRM, and ERP. In the Nigerian manufacturing context, more detailed research is required to break down the various ICT types (such as advanced analytics, IoT, blockchain, cloud computing, artificial intelligence, and machine learning) and examine their unique effects on various aspects of supply chain performance (such as supply chain agility, resilience, visibility, cost reduction, sustainability performance, lead time reduction, and demand forecasting accuracy). Specifically, this present study examines manufacturing firms in Cross River State which other exiting studies have not captured. Also, barcode as independent variable dimension has not been studied in Nigerian context.

METHODOLOGY

The study used a descriptive and survey design. This is due to the researcher's intention to sample respondents' opinions regarding the use of ICT tools in the supply chain of Cross River State manufacturing companies. The employees, distributors, and wholesalers of the manufacturing firms in Cross River State made up the study's population. Lafarge Cement Plc provided 320 distributors and wholesalers and 295 employees, while Niger Mills, Calabar, provided 230 employees and 284 distributors and wholesalers. However, using the Taro Yamane formula, a sample size of 297 was selected from the population. The study adopted convenience sampling technique. Convenience sampling is a non-probability sampling technique where participants are selected based on their easy accessibility and proximity to the researcher. It is also known as opportunity sampling or availability sampling. In this

method, researchers choose individuals who are readily available and willing to participate in the study, rather than employing a random selection process

The services of research assistants were employed to physically administered and retrieved the study instrument. A well- designed 5-point likerts scale questionnaire, named “Information and Communication Technology Tools and Supply Chain Performance Questionnaire (ICTTSCPQ)” is the instrument used for this study. The researchers used the content validation model to validate the survey instrument. To ensure that the statements matched the objectives of the study, copies of the questionnaire were given to experts in supply chain and marketing, who could offer knowledgeable commentary. An instrument's reliability was determined by how well it can produce consistent results over time. The reliability of the instrument was evaluated using the test-retest option and the Cronbach Alpha method. A pilot survey was completed by thirty individuals. The data were used to compute the alpha and the standardized coefficient. Using SPSS version 23, multiple regression was used to test the study's hypotheses at the 0.05 level of significance, while descriptive statistics were used to precisely analyze the data.

ANALYSIS AND RESULTS

Table 1

Regression model summary showing the impact of ICT on supply chain performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.795 ^a	.632	.625	6.04805

- a. Predictors: (Constant), Barcode scanner, Radio frequency identification, Electronic data interchange

Table 2

ANOVA^a showing the impact of ICT tools and supply chain performance of manufacturing firms in CRS

Odel		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	17325.823	5	3465.165	94.731	.000 ^b
	Residual	10095.780	276	36.579		
	Total	27421.603	281			

- a. Dependent Variable: Performance

- b. Predictors: (Constant), Barcode scanner, Radio frequency identification, Electronic data interchange,

Table 3

Coefficients^a showing the impact of ICT on supply chain performance

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1	(Constant)	101.760	2.332	43.642	.000
	Barcode scanner	.893	.105	.319	8.511 .000
	Radio frequency identification	1.384	.128	.514	10.789 .000
	Electronic data interchange	.458	.128	.182	3.578 .000

a. Dependent Variable: Performance

The aforementioned multiple regression analysis looked at how ICT affected the supply chain performance of Cross River State manufacturing companies. The statistics and analysis findings from Tables 2 and 3 are summarized in Table 1 above. According to the tables, the predictor variables (barcode scanner, radio frequency identification, and electronic data interchange) contributed 63% to the overall regression model, with the remaining 37% being influenced by exogenous factors not taken into account in the study. The correlation coefficient (R) was .795a, and the coefficient of determination (R²) was .632. More specifically, the results suggest that the supply chain performance of manufacturing companies in Cross River State is significantly impacted by barcode scanners (B = .319, Sig = .000 < P = .05), radio frequency identification (RFID) (B = .514, Sig = .000 < P = .05), and electronic data interchange (EDI) (B = .182, Sig = .000 < P = .05). The above result implies that each predictor variable contributes independently to the regression model, as shown by the beta values. The most significant contributions are made by radio frequency identification (RFID) (B = .514, t = 10.789 P < .05), barcode scanners (B = .319, t = 8.511, P < .05), and electronic data interchange (EDI) (B = .182, t = 3.578, P < .05). According to the aforementioned, the null hypotheses are rejected, but the alternative hypotheses of hypotheses 1, 2, and 3 are accepted since their p-values are less than .05.

Discussion : This study's primary goal was to investigate the supply chain performance and information and communication technology of manufacturing companies in Nigeria's Cross River State. The goal of the study is to determine how manufacturing firms' performance is impacted by barcode scanners, radio frequency identification, electronic data interchange, enterprise resource planning, and global positioning systems. Barcode scanners have a significant influence on manufacturing companies' supply chain performance. This result is in support of Coyle, et al, (2003). Manufacturing companies' supply chain performance is

significantly influence by radio frequency identification. This result is in support of Kareem, (2023). The performance of manufacturing companies' supply chains is greatly influenced by electronic data interchange. This result is in support of Coyle, et al,(2003). The practical implication of these results is that, ICTs can streamline processes, leading to shorter response times, better logistics management, and enhanced collaboration among supply chain partners.

CONCLUSION AND RECOMMENDATIONS

The study "information and communication technology and supply chain performance of manufacturing firms in Calabar, CRS, Nigeria" came to the following conclusions: Barcode scanners have a significant influence on the supply chain performance of manufacturing firms in CRS. The study's findings indicate that barcode scanners are relevant in today's world because they improve asset visibility, provide prompt information, and reduce human error, among other things. As a result, manufacturing firms find it very easy to communicate with channel members, access product information, and control inventory in order to meet their goals. The performance of manufacturing companies' supply chains in CRS is significantly impacted by radio frequency identification. Given that the supply chain refers to the method by which goods and services are delivered to customers, some channel participants—particularly distributors and wholesalers who purchase goods in bulk—often want to stay in contact with their products even while they are in transit. Determining a product's status and position by channel members boosts confidence, gets rid of fear, and advances the Just-In-Time concept. The performance of manufacturing companies' supply chains in CRS is also significantly impacted by electronic data interchange. Because it lowers processing costs and errors associated with data entry and manual document production, EDI is essential to supply chain management today. In an effort to improve process efficacy and efficiency, some supply chain participants even install software on their PCs to monitor inventory, facilitate communication, and even generate invoices, bills, and receipts as soon as payment is received and verified.

In light of the aforementioned findings, the following suggestions are offered:

1. Because of the clear impact on performance, manufacturing companies should use ICT tools like barcode scanners, RFID, and EDI in their supply chain operations.
2. This study has shown that there is a significant relationship between the supply chain performance of manufacturing firms and ICT tools like barcoding, RFID, and EDI. Therefore, supply chain members who have not yet implemented the use of ICT tools in their operations should make an effort to do so.

3. Distributors, wholesalers, and top management/board of directors should work to provide the facilities required to support the integration of ICT into their supply chain operations. They should also periodically host seminars to educate employees on ICT usage.

REFERENCES

- Attaran, M. (2007). RFID: an enabler of supply chain operations. *Supply Chain Management: An International Journal*, 12(4), 249-257.
- Bharadwaj, A. (2000). A resource-based perspective on information technology capability and firm performance: an empirical investigation, *MIS Quarterly*, 24.
- Cohen, G., Salomon, I., & Nijkamp, P. (2002). Information-communication technology (ICT) and transport: does knowledge underpin policy? *Journal of Systems and Information Technology*, 26(2), 34-41.
- Coronado, A. E., Andrew, C., Lyons, M, Z., & Dennis, F. K. (2004). Automotive Supply Chain Models and Technologies: A Review of Some Latest Developments.
- Coyle, J. J., Bardi, E. J. & Langley, C. J. (2003). *The Management of Business Logistics: A Supply Chain Perspective* (7th ed.). South-Western/Thomson Learning.
- D'Avanzo, R., Starr, E. & Von-Lewinski, H. (2004). Supply Chain and the Bottom Line: A Critical Link. *Outlook: Accenture*, No. 1, 39-45
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340. <https://doi:10.2307/249008>
- Davis, F. D., Bagozzi, R. P. & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science Journal*, 35(8), 982–1003.
- Drazin, R. (1991). The processes of technological innovation. *The Journal of Technology Transfer*, 16(1), 45–46. <https://doi.org/10.1007/BF02371446>
- Effy, O., & Andy, J. (2008). *Management information systems* (5th ed.). Cabrian Printers.
- Ellram, L. M., La-Londe, B. J. & Weber, M. M. (1999). Retail logistics. *International Journal of Physical Distribution & Logistics Management*, 29(7/8), 477-494.
- Flynn, B. B., Huo, B. & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management*, 28(1), 58-71.
- Garcia-Dastugue, S. J. & Lambert, D. (2007). Inter-organizational time-based postponement in the supply chain. *Journal of Business Logistics*, 28(1), 57-81.

- Gbede, G. (2005). *Strategic Mergers & Acquisitions*. Lagos, Westbourne Business School.
- Greenstein, M. & Feinman, T. M. (2000). *Electronic Commerce: Security, Risk Management and Control*. McGraw-Hill.
- Hensher, D. A. & Button, K. J. (2001). *Handbooks in Transport 2. Handbook of Logistics and Supply-Chain Management*, Pergamon, UK.
- Inameti, E.E. (2022). Service Quality Strategies and Performance of Hotels in CrossRiver State, Nigeria. *International Journal of Advances in Engineering and Management*, 4(12), 587 – 603.
- Jack, R., M. & Samuel J. M. (2006). *Project Management: A Managerial approach*, (6th Ed.). John Wiley & Sons, Inc.
- Jedermann, R., Ruiz-Garcia, L. & Lang, W. (2009). Spatial temperature profiling by semi-passive RFID loggers for perishable food transportation. *Computers and Electronics in Agriculture*, 65, 145-154.
- Kareem, T. S. (2023). Supply Chain Information Technology (SCIT) and Organizational performance: Evidence from Nigerian Manufacturing Industry. *Journal of Economics, Management & Business Administration*. 2(1). 29-42.
- Kotler, P. (2003). *Marketing Management* (11th ed.). Upper Saddle River, USA: Prentice Hall.
- Lambert, D. M., Cooper, M. C. & Pagh, J. D. (1998). Supply chain management: implementation issues and research opportunities. *International Journal of Logistics Management*, 9(2), 1-19.
- Liu, H. J., Wang, X. & Yang, Y. (2011). Strategy research on manufacture ERP planning based on TOE-TAM model. *Science and Technology Management Research*, 13(2), 163–166.
- Lyons, K. (1998). *Purchasing*. (1st ed.). Westbourne publishers.
- Mirza, (2013). Determinants of financial performance of a firm: Case of Pakistani stock market. *Journal of Economics and International Finance*, 5(1), 43-52.
- Neely, A., Gregory, M. & Platts, K. (2005). Performance measurement system design: A literature review and research agenda. *International Journal of Operations & Production Management*, 25(12), 1128–1263.
- Neely, A., Gregory, M. & Platts, K. (2005). Performance measurement system design: A literature review and research agenda. *International Journal of Operations & Production Management*, 25(12), 1128–1263.

- Nickels, W. G. & Wood, M. B. (1997). *Marketing: Relationship, quality, value*. Worth Publishers, (4th ed.)
- Paulraj, A., Chen, I. J. & Flynn, J. (2017). Levels of strategic purchasing: impact on supply integration and performance. *Journal of Purchasing & Supply Management*, 12(1), 107-22.
- Puschmann, T. & Alt, R. (2005). Successful use of e-procurement in supply chain. *Supply Chain Management: An International Journal*, 10(2), 122-133.
- Rajiv, B. (2010). Impact of technology on logistics and supply chain management. *Journal of Business and Management*, 1(7), 19-24.
- Reynolds, J. (2001). *Logistics and Fulfillment for e-Business, a Practical Guide to Mastering Back Office Functions for Online Commerce*. CRC Press.
- Ross, D. F. (2003). *Introduction to e-Supply Chain Management: Engaging Technology to Build Market Business Partnerships*. St. Lucie Press.
- Rushton, A., Oxley J. & Croucher, P. (2000). *IT in the supply chain: The Handbook of Logistics and Distribution Management*. Great Britain: Bell & Bain Ltd, Glasgow.
- Sabbaghi, A. & Vaidyanathan, G. (2008). Effectiveness and efficiency of RFID technology in supply chain management: Strategic values and challenges. *Journal of Theoretical and Applied Electronic Commerce Research*, 3(2), 71-81.
- Sanchez, A. & Perez, M. (2003). The use of EDI for interorganisational co-operation and co-ordination in the supply chain. *Integrated Manufacturing Systems*, 14(8), 642-651.
- Songer, A., Young, R. & Davis, K. (2001). Social architecture for sustainable IT implementation in AEC/EPC. In *Proceedings of IT in Construction of Africa*, Mpumalunga, South Africa.
- Venkatesh, V. & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: *Four longitudinal field studies: Management Science*, 46(2), 186–204.
- Zhirong, C., Ling, Z. & Yu, T. (2010). Application of GIS/GPS Technology in Mobile Logistics Public Information Platform. *IEEE International Conference, College of Science NUoTN*. China.