NEXUS BETWEEN ARTIFICIAL INTELLIGENCE, SUPPLY CHAIN TECHNOLOGY AND FINANCIAL PERFORMANCE OF LISTED INFORMATION AND COMMUNICATION TECHNOLOGY FIRMS IN NIGERIA

INUWA, Mohammed Bala
Department of Accounting and Finance,
Baze University, Abuja
mohammed.inuwa@bazeuniversity.edu.ng
+234 7068187904

ABSTRACT

Information and communication technology companies hugely invest in artificial intelligence and supply chain technologies and so the need arises to study the effect that these have on the financial performance of these companies, to find out whether these innovations have any significant synergistic benefits to the advancement or abatement of financial numbers. This study therefore, is an assessment of the effect of artificial intelligence and supply chain technology on the financial performance of listed information and communication technology firms in Nigeria. The study which covers a fifteen (15) year period (2009-2023), adopted secondary data sourced from published annual reports and accounts of the listed ICT firms according to the Nigerian Exchange Group, to ensure the validity and reliability of the data. The findings indicated that artificial intelligence and supply chain technology both had positive effect on financial performance, but artificial intelligence had a significant influence while supply chain technology is insignificant. The study concludes that increase in the use of artificial intelligence will improve financial performance and it is recommended that more artificial intelligence technologies should be adopted by Information and communication technology firms.

1. INTRODUCTION

A firm's financial performance pertains to the various subjective ways of measurement of how a firm can use its given assets from primary mode of operation to generate earnings and this can be measured by analyzing and evaluating the company's financial statements. Profit is the goal of the firm and to measure profitability, there are a variety of ratios used which includes return on assets (Nasamu, 2020). Return on assets (ROA) as a profitability measure is used as a tool to measure the rate of return on total assets after interest, expense and taxes. The primary objective of any business is to turn a profit, and ICT companies are no different. A high return on assets (ROA) for an ICT company indicates that the management has been able to administer the resource entrusted to them adequately and in turn makes the company more profitable.

The rapid growth of the internet and its role in the transfer of data between telecommunication networks has blurred and blended the boundary between telecommunication equipment and information technology (IT) hardware.

Corresponding Author:
INUWA, Mohammed Bala
Department of Accounting and Finance,
Baze University, Abuja
mohammed.inuwa@bazeuniversity.edu.ng
+234 7068187904

This blending is now defined as information and communications technology (ICT), which emphasizes the integration of telecommunications (telephone lines and wireless signals), computers, enterprise software, middleware, storage, and audiovisual systems that allows users to access, store, transmit, and manipulate information (Roberta, 2019). Hence, this rapid advancement in technology has created disruption in the existing pattern and modes of service deliveries of several organisations. These disruptions can be seen in areas relating to the use of artificial intelligence and the involvement of supply chain technology. As these technologies continues to evolve and reshape business models, pushing companies to find an innovative way to deal with its unpredictable and fast changing environment, the negative impact of it is that these technologies, continue to pose some challenges for industries worldwide, and firms are constantly learning how to adapt in order to survive (Zainal, 2021).

According to Nurudeen (2023), in modern business operations, supply chain efficiency is a critical factor in meeting consumers' demands at the right time and the right place. Efficient supply chains are the lifeblood of businesses, encompassing the smooth flow of materials, information, and services from suppliers to end customers. Ensuring the efficiency of a company's activities in today's highly competitive global markets is characterized by the need to organize a marketing and logistics system amenably with the latest technology conditions and trends supporting strategic business goals and objectives (Al Humdan, Shi, Behina, Chowdhury & Mahmud, 2023). The emerging technologies are said to have a great potential to transform the ways of living and the business operating models of companies all over the world. It becomes important to study both the capabilities and limitations of machine intelligence and its potential impact in human life, society and business. (Soni, Sharma, Singh & Kapoor, 2018). Some scholars including Pavaloaia and Necula (2023) and Ogomegbunam (2023) have stated that artificial intelligence and supply chain technologies have a significant effect on financial performance, while some others have a contradicting opinion including Amole et al (2021) who stated that without implementing the key factors of supply chain there would not be a significant improvement in financial performance, and Ransbotham, Mitra & Goh (2021) who noted that there are instances where misalignment and rushed adoption of artificial intelligence led to financial strain.

This gap in knowledge poses a challenge for firms seeking to optimize operations and gain competitive advantages. Therefore, this study aims to examine the effect of artificial intelligence and supply chain technology on the financial performance of listed Nigerian Information and Communication Technology firms, providing insights to inform strategic decision-making and drive industry growth while also adding to the vast body of knowledge already in place as far as knowledge on the ICT industry is concerned using variables that are more specific to the ICT industry**.** The choice of industry used stems from the fact that the ICT sector is at the forefront of technological advancement in the country. The timeframe for this study will be 15 years, ranging from years 2009 to 2023 with a view to assessing the effect of artificial intelligence and supply chain technology on financial performance of Information and communication technology firms in Nigeria. The hypotheses of the study stated in their null form are;

$H0_1$: Artificial intelligence does not have a significant effect on the return on assets of listed Information and Communication Technology firms in Nigeria.

$H0_2$: Supply chain technology does not have a significant effect on the return on assets of listed Information and Communication Technology firms in Nigeria

This study is divided into five main sections: Introduction, Literature Review, Methodology, Results and Discussion, and Conclusion. The Introduction provides the background, identifies the research problem, and states the hypothesis. The Literature Review critically analyzes previous studies related to the topic, offering a foundation for the current research. The Methodology section outlines the research design, data collection processes, and methods of analysis. The Results and Discussion section presents the study's findings and interprets them in light of existing literature. Finally, the Conclusion summarizes the key outcomes, draws relevant conclusions, and proposes directions for future research.

2. LITERATURE REVIEW

2.1 Conceptual Framework

2.1.1 Artificial Intelligence

Artificial Intelligence (AI) is a technique for having a computer, a computer-controlled robot, or software think intelligently in a way that is comparable to the human mind (Ezeribe, 2019). There are several definitions available, but the majority of them can be stated as systems that think like humans, act like humans, think rationally, and act rationally (Kok, Boers, Kosters, Putten, Van Der & Poel, 2010). Artificial intelligence is a catch-all term for all types of machine intelligence. However, there are multiple, different and distinct areas of AI study and application, even if they occasionally overlap. Types of AI technologies include speech recognition, computer vision, natural language processing, expert support systems, and machine learning.

Speech recognition, also known as speech to text, is a type of AI that entails recording and digitising sound waves, changing basic linguistic units or phonemes, creating words from phonemes, and contextually analysing the words to guarantee that words that sound the same are spelled correctly (Smadi, Al Issa, Trad & Smadi 2015). Natural language processing (NLP) is a branch of (AI) that aims to help computers comprehend how humans write and communicate. People utilise NLP on a daily basis in the following ways: search engine related keywords, spell check, autocomplete, voice text messaging, spam filters, Siri, Alexa, or Google Assistant. An expert system is a computer software that tries to imitate human experts by providing guidance, teaching, and executing intelligent tasks. In artificial intelligence, an expert system is a computer system that models the decision-making abilities of a human expert. (Leung, 2009). Machine learning is a discipline of AI that focuses on using data to create computer systems that can learn and improve over time (Wehle, 2017). At its most basic, machine learning refers to any type of computer software that can "learn" without being expressly programmed by a human.

According to Adebayo and Olorunfemi (2022) utilizing AI for customer service automation, predictive analytics, and decision-making processes, companies have been able to reduce operational costs while improving the quality of services provided, ultimately leading to better profitability. Similarly, Okoro and

Nwachukwu (2023) documented that AI technologies such as machine learning algorithms and natural language processing helped firms anticipate market trends, enhance customer engagement, and improve customer retention, which resulted in increased revenue and profitability. However, Adebayo (2024) noted that despite the positive impact of AI on financial performance in the long run, some firms struggled with high initial investment costs and the need for continuous workforce training. As a result, the financial gains were slower for these firms, especially in the short term.

2.1.2 Supply Chain Technology

As billions of devices connect to the internet, ICT companies strive to meet the growing demand for faster and more reliable networks and technology (Lee, 2021). The ICT supply chain encompasses the entire process of designing, manufacturing, distributing, and maintaining communication devices and networks. It involves multiple stakeholders, including equipment manufacturers, software developers, service providers, and network operators. The information and communications technology (ICT) supply chain is a globally-interconnected ecosystem that involves CT software, hardware, and services including suppliers, vendors, and contractors. The general definition of a supply chain is the acquisition of resources and materials, the combining of these raw resources and materials into a product, and the delivery of the product to the end consumer. In other words, it's how raw materials are transformed into a final product. The ICT supply chain specifically refers to the chain of actions that transforms raw resources into ICT products and services such as computer hardware and software, applications, and cloud subscriptions. In some cases, this supply chain relies on the physical movement and manufacturer of objects (such as microchips). In other cases, it relies on distribution and access to services via telecommunication infrastructure — cables, the internet, the cloud, etc. (Roberta, 2019). An ICT supplier is any business that offers ICT products or services to individuals or other organizations. It includes providers of electronic components or the raw materials used to produce those components. It also includes software and cloud providers as well as managed services. The telecommunications industry is known for its rapid evolution and constant innovation. As technology continues to advance, so does the need for efficiency in the supply chain that supports this industry. In order to keep up with the increasing demands of consumers,

ICT companies are continuously exploring new ways to optimize their supply chain operations. According to Security scorecard (2023), some of the technology being adopted to revolutionise the efficiency of the supply chain include; Internet of Things (IoT) and Connected Devices which refers to the interconnected network of devices that can communicate and exchange data with each other.

A study by Okafor et al. (2021) found that these technologies improved supply chain visibility, reduced lead times, and minimized inventory costs, contributing positively to financial performance by reducing operational costs and enhancing efficiency. Nnamdi and Chigozie (2022) added that blockchain improved supply chain transparency, reduced fraud, and minimized the time taken for transactions. As a result, companies experienced cost savings and improved financial performance. Eze and Onu (2023) opined that integrating advanced technologies significantly improved financial performance. Real-time tracking of inventory, better procurement processes, and reduced waste resulted in lower operational costs and higher profitability.

2.1.3 Financial performance

In many business literatures, financial performance is defined as the process of quantifying a firm's activities and operations which contribute to the attainment of its goals and objectives through satisfaction of its stakeholders, especially the customers, (Effiong & Ejabu, 2020). Aminu and Shariff (2015) also described a company's performance as the measurement of how successfully its goals and objectives are met in comparison to its competitors; the accomplishments are the result of efficient, effective and productive business operations.

A firm's financial performance is of importance to investors, stakeholders and the economy at large. The investors are interested in the returns for their investment as a business that is performing well can bring better reward to their investors. Abidde (2021) opined that researches on the firm's financial performance emanates from organizations theory and strategic management where the notion of financial performance is used to describe performance of an entity with the legal status of a company. Financial performance presented in the financial statements prepared periodically by companies is meant to provide users reliable information about the company's performance and financial position. Although measuring financial performance is considered a simple task, it also has its specific complications.

According to Akinboade (2020), the performance of an entity can be broadly measured in two ways, financial and non-financial. The two measures which represent different perspectives of how to evaluate a firm's performance, have different theoretical implications and each are subject to particular biases. The financial indicators of financial performance of an organisation includes profitability, sales turnover, return on investment, shareholders fund/net asset, profit before tax, profit after tax and cash flow; while the non-financial ways are market share, number of employees, product quality and employee turnover. The use of different measures in measuring financial performance, needless to say, complicates the comparison of the results of different studies.

2.1.4 Return on Assets

Return on Assets (ROA) is a profitability ratio that provides how much profit a company can generate from its assets. ROA measures the return on all assets of the company and is often used as an overall index of profitability. In other words, return on assets (ROA) measures how efficient a company's management is in earning a profit from their economic resources or assets on their balance sheet (Boyte-White, 2022). The return on assets (ROA) is a profitability metric that measures the efficiency at which a company can utilize its assets to generate more net earnings. Return on assets (ROA) refers to a financial ratio that indicates how profitable a company is in relation to its total assets (Otti, Udeh, Amahalu & Obi, 2022). Corporate management, analysts, and investors can use ROA to determine how efficiently a company uses its assets to generate a profit. A higher ROA means a company is more efficient and productive at managing its statement of financial position to generate profits while a lower ROA indicates there is room for improvement (Ezechukwu, Amahalu, & Okudo, 2022). ROA can be increased by increasing profit margin or asset turnover. ROA is expressed in percentage, the result of dividing the net profit by the average total assets should be multiplied by 100 (Tamplin, 2022).

@A Publication of the Department of Economics, ADSU, Mubi. ISSN- Print: 2550- 7869; ISSN-Online: 3043-5323. Journal homepage: https://ajaefm.adsu.edu.ng

ROA = Net Profit / Total Assets X 100

2.1.5 Firm Growth

Firm growth is a critical phenomenon that has garnered significant attention in academic and business circles due to its implications for organizational strategy, market competition, and economic development. It encompasses various dimensions such as sales growth, employee growth, market share expansion, and increases in assets, which together depict the scale and trajectory of a firm's expansion over time. In research, firm growth is often used as a control variable to account for its potentially confounding effects on the relationships between other variables of interest. Firm growth can be seen as the increase in a firm's scale of operations, which can be measured through multiple dimensions. The most common measures include: revenue growth which is the percentage increase in sales over a period, asset growth which is the increase in the firm's total assets, reflecting investments and acquisitions, employee growth, representing the rise in the number of employees, indicating expansion in workforce, and market Share Growth, the increase in a firm's proportion of total market sales, showcasing competitive gains. These measures capture different aspects of growth, providing a comprehensive view of a firm's expansion. For instance, revenue growth reflects market demand and sales performance, while employee growth indicates organizational scaling and capacity building (Davidsson & Wiklund, 2010).

2.2 Empirical Review

Nurudeen et al (2024) examines the impact of technological innovations on supply chain efficiency, the sample size was 30 carefully selected SMEs in the manufacturing sector, representing 10 SMEs each from the three senatorial zone in Lagos. Out of 150 questioneers distributed, only one hundred and twenty-three (123) respondents duly completed their instruments, while PPMCC was used to analyse the hypotheses. The study revealed that technological innovations as measured by marketing innovations, transportation technology and information technology have a significant relationship with supply chain efficiency as measured with inventory turnover and transportation costs. The study recommended that SMEs should endeavor to adopt all necessary innovations that will further improve their supply chain and invest in robust technological innovation to enhance the supply chain capacity. This study, however, focuses exclusively on manufacturing companies in Lagos State, which may limit its representation of the broader manufacturing industry in Nigeria.

Pavaloaia and Necula (2023) examined artificial intelligence as a disruptive technology- a systematic literature review on how disruptive technologies have evolved over time and their current acceptation. Based on a sentiment analysis of the titles and abstracts, the results reveal that the majority of recent publications have a positive connotation with regard to the disruptive impact of edge technologies, and that the most prominent examples (the top five) are AI, the IoT, blockchain, 5G, and 3D printing. To conclude, the disruptive technologies definitely provide more advantages than disadvantages in healthcare (medicine), business, agriculture, education, and urban development, and only the future will demonstrate the correctness of such a statement. Businesses and individuals should therefore be aware that the disruptive effects of AI technology are still changing how people interact in the corporate, consumer, and professional sectors, while 5G and other

mobile technologies will become highly disruptive and will genuinely revolutionize the landscape in all sectors in the upcoming years. However, the ethics concerning the use of AI and other disruptive technologies in the selected sectors have also been neglected by the article

Ogomegbunam (2023) explores the effect of supply chain management practices on manufacturing firms' performance in Delta state, Nigeria. This study considered supply chain management (SCM) practices and manufacturing firms' performance in Delta State, Nigeria. The descriptive survey research design was employed. Data were elicited from the employees of the thirty (30) manufacturing firms registered under the Manufacturing Association of Nigeria (M.A.N.), Delta State Chapter as at 30th June 2021 and are also registered with the Corporate Affairs Commission (CAC). The population of the study is 150 employees comprising only the managers, heads of: production department, logistics department, customer service department, and accounting department and the total enumeration sampling technique were used. The instrument for data collection is the questionnaire. The study concluded that a significant relationship exists between all the studied dimensions of SCM and the nonfinancial performance of manufacturing firms in Delta State, Nigeria, which implies that an increase in the practice of these SCM dimensions would lead to a corresponding increase in their non-financial performance. Based on the findings, the researcher recommended that manufacturing firms in Delta State no doubt, recognize the essence of valuable SCM practices in their operations. Based on this, the Manufacturing Association of Nigeria should continually encourage these firms to uphold these practices by using them as benchmark for raising the standard of manufacturing firms across Nigeria.

Shiyyab et al (2023) studied the Impact of Artificial Intelligence Disclosure on Financial Performance. This study determines to what extent Jordanian banks refer to and use artificial intelligence (AI) technologies in their operation process and examines the impact of AI-related terms disclosure on financial performance. Content analysis is used to analyze the spread of AI and related information in the annual report textual data. Based on content analysis and regression analysis of data from 115 annual reports for 15 Jordanian banks listed in the Amman Stock Exchange for the period 2014 to 2021, the study reveals a consistent increase in the mention of AI-related terms disclosure since 2014. However, the level of AI-related disclosure remains weak for some banks, suggesting that Jordanian banks are still in the early stages of adopting and implementing AI technologies. This therefore creates a gap in this literature as the low adoption indicates that the results from the study may not be a true representation of the industry at large. The results indicate that AI-related keywords disclosure has an influence on banks' financial performance. AI has a positive effect on accounting performance in terms of ROA and ROE and a negative impact on total expenses, which supports the dominant view that AI improves revenue and reduces cost and is also consistent with past literature findings. It is therefore recommended that AI related disclosures should be encouraged since it is only still the early stages.

Anajaa & Bagobiri (2022) examined the effect of supply chain management on organizational performance of selected fast moving consumer goods in Karu local government area. The study employed a survey research design and data used was primary data. The questionnaire was the data collection instrument used in collecting primary data and it was worded in a positive tone. The population of the study was the employees in charge of supply chain management decisions which were 632. The sample size was gotten by way of Taro Yamane

formula and was 245, the total number of questionnaires distributed was 319 with 300 returned. Data was presented via tables and analyzed by way descriptive statistics, correlation analysis and multiple regression analysis. The study found that strategic supplier partnership, customer relationship management and information sharing all have a statistically significant effect and relationship on organizational performance, with information sharing being the highest contributor. The study concluded that supply chain management had a positive and significant effect on organizational performance of selected fast-moving consumer goods in Karu L.G.A. Although, the use of questionnaire to carry out data collection may give room for bias and subjective judgements, the study recommended that the organizations should emphasize and be consistent with these supply chain management practices as they are critical in increasing organizational performance in an effective and efficient manner.

Finkenwirth (2021) investigated the impact of artificial intelligence on financial performance in the German financial service industry – a content analysis. Artificial Intelligence is one of the main drivers of Industry 4.0, thus, the study assesses the impact of mentioning AI-related terms in annual reports on financial performance. By focusing on domestic listed German companies in the financial service industry, this research contributes to understanding the AI-adoption stage. A quantitative research design is applied by reviewing a sample of 84 companies and 323 annual reports over four years. All in all, the findings show a linear increase in mentioning AI-related terms, and as the trend of AI adoption is still developing, and the financial benefit takes time to realise, it is recommended that plenty of research is carried out to contribute to a deeper understanding of business implications. However, AI-related terms do not provide sufficient explanatory power of financial performance, even though some evidence exists supporting a positive impact.

Serge-Lopez et al (2020) analyzed the influence of Artificial Intelligence (AI) on firm performance, notably by building on the business value of AI-based transformation projects. The research process was based on a review of 500 case studies from IBM, AWS, Cloudera, Nvidia, Conversica, Universal Robots websites, etc. Specifically, this article, through these case studies, exposes the influence of AI at both the organizational and process performance levels, while considering it not as a single technology but as a set/combination of the several different configurations of IT in various industries. Studying the influence of AI on the performance of organizations, and more specifically of the business value of such, the results of our study have highlighted AI benefits in organizations, and more specifically its ability to improve on performance at both the organizational (financial, marketing and administrative) and process levels. Therefore, practitioners and researchers need to consider AI as a valuable support or even a pilot for a new business model. Case study research faces some limitations, as with any empirical research. The data collected within the framework of a case study are not spontaneous, but secondary. Also, case study data may have been inherited with missing data. Although the case studies provided a significant amount of information, there may have been an element of bias in the data contained in the cases, such as exaggerated claims or even restrictions on published data.

2.3 Theoretical Framework

2.3.1 Disruptive Innovation Theory

The theory of disruptive innovation was introduced by Clayton Christensen in 1997 in his book *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. This theory is particularly useful for analyzing the impact of groundbreaking technologies on a firm's performance. The theory explains how innovation can transform an existing industry or market by introducing innovations that offer greater convenience, affordability, and accessibility, especially in markets or sectors typically characterized by complexity and high costs. Disruptive innovations typically emerge in niche markets that initially appear unattractive or insignificant to established industry players but eventually disrupt and transform the entire industry. The theory helps explain how local products and services evolve to the point of displacing traditional industries, often replaced by high-tech alternatives. There is considerable evidence of disruptive innovation achieving great success across various industries, with several major global companies adopting it (Sunday, Fadenipo, Okoi & Nwafor, 2021).

Christensen defines disruptive innovation as a process where a product or service initially takes hold at the lower end of a mature market, eventually progressing upmarket and displacing established competitors (Hang & Yu, 2010). This process creates a new market and value network, which disrupts the existing market and the leading firms within it. The theory suggests that disruptive innovations often come from entrepreneurs or outsiders who are not part of the established market-leading companies. This is because existing businesses may not be willing to pursue innovations that are initially less profitable, especially since such developments require investments that could divert resources away from sustaining existing products. Christensen also points out that the risks of investing in disruptive innovations are higher compared to sustaining innovations, and the development process for disruptive innovations typically takes longer. He differentiates between sustainable technologies, which enhance existing products, and disruptive technologies, which redefine or disrupt performance standards.

The foundational theory of this study is disruptive innovation theory. It suggests that new technologies can change the competitive landscape and create advantages for firms. By analyzing financial data and performance metrics from ICT firms that have implemented these technologies, the study aims to assess how these innovations have influenced financial performance. Some findings indicate that certain firms have seen significant improvements, while others have encountered challenges that hindered financial growth, highlighting the complex relationship between technology adoption and financial outcomes in Nigeria's dynamic ICT sector.

3. METHODOLOGY

This study employs an ex post facto research design to examine the impact of artificial intelligence and supply chain technology on the financial performance of Information and Communication Technology (ICT) firms in Nigeria from 2009 to 2023.

The population for this study consists of all eight (8) listed Information and Communication Technology (ICT) firms in Nigeria at the time of this research. Given the nature of the data and the size of the population, the analysis will be based on data from all eight firms, meaning the census sampling size was adopted. This

approach ensures a true representation of the population. Data for the study were collected from the annual reports of each firm for the specified period, and a panel multiple regression model was employed for the analysis.

The study conducted several tests, including descriptive statistics, correlation matrix, variance inflation factor, heteroskedasticity test, Hausman specification test, LM test, and panel data regression, using the E-View (12) statistical software. With artificial intelligence and supply chain technology as the independent variables and financial performance as the dependent variable, the model considered in this study is based on the functional relationship between these variables.

$ROA = \beta_0 + \beta_1 AI + \beta_2 SCT + \beta_3 FG + \varepsilon$

Where:

ROA = Return on Assets

β= constant

AI = Artificial intelligence

SCT = Supply chain technology

FG = Firm Growth

ε = error term

For this study, the apriori expectation is that ICT firms adopting artificial intelligence and supply chain technology will exhibit superior financial perform

Table 3.1: Summary of Variables Measurement

Variable	Type	Measurement	Sources
Return on Asset (ROA)	Dependent	Net Profit divided by Total Assets X 100%	Sunday *et al* (2021)
Artificial intelligence (AI)	Independent	Dummy variables are used to represent whether or not they made such investment. 1 representing yes and 0 representing no.	Sunday *et al* (2021)
Supply chain technology (SCT)	Independent	Inventory turnover ratio- Cost of sales / Average inventory X 100%	Didia and Gladson (2015)
Firm Growth (FG)	Control variable	Natural logarithm of Revenue	Giroud and Muller (2017)

Source: Researcher Compilation, (2024)

4. RESULTS AND DISCUSSION

4.1 Descriptive statistics

This section presents the descriptive statistics, summarizing the sample and variables related to the impact of supply chain technology and artificial intelligence on the financial performance of ICT firms in Nigeria. By providing insights into distributions, means, and variabilities, these statistics establish a foundational understanding for subsequent analyses.

Table 4.1: Descriptive Statistics Results

Date: 08/24/24 Time: 11:35
Sample: 2009 2023

	ROA	AI	SCT	FG
Mean	-0.358196	0.533333	2409.589	22.62263
Median	2.127436 173.0423	1.000000 1.000000	340.1709	22.60155
Maximum	-52.55913	0.000000	38565.44	28.53477
Minimum	21.22945 4.158949	0.500979	0.000000	13.19932
Std. Dev.	38.79877	-0.133631	6640.479	3.300465 -
Skewness		1.017857	4.313553	0.281248
Kurtosis	6753.696		22.23280	3.013492
	0.000000	20.00159		
Jarque-Bera		0.000045	2221.638	1.582919
Probability	-42.98350		0.000000	0.453183
	53632.06	64.00000		
Sum	120	29.86667	289150.7	2714.715
Sum Sq. Dev.		120	5.25E+09	1296.275
Observations			120	120

Source: Researcher Computation (2024)

The descriptive statistical result presented in table 4.1 above indicates that Return on Asset (ROA) during the period under study has minimum and maximum percentage values of -52% and 173 % respectively. The average amount of mean to ROA disbursed during the period is 0.358% with standard deviation of 21%, implying that, the data deviated from the both sides of the mean by 21%. This suggests that, the data on ROA is quite widely dispersed from the mean during the sample period, as the standard deviation was found to be high. The co-efficient of skewness of 0.877520 suggests that the ROA data is positively skewed and did not comply with the symmetrical distribution assumption. Furthermore, AI and SCT have a mean of a 0.53 and 2728 respectively with standard deviations of 0.5 and 7398 respectively. This goes on to show that SCT has the highest deviation from the mean among all variables. In like manner, the study found that firm growth

has a mean of 22.62 and a median of 22.60 while the maximum and minimum firm growth of ICT firms in Nigeria are 28.53 and 13.19. From the probability of the variables, it shows that AI and SCT are normally distributed because they have probability greater than 5% .

4.2 Correlation Analysis

The correlation analysis determines the degree of linear association between the dependent and independent variables. The sign of the correlation coefficient, either positive or negative indicates the direction of the association, while the magnitude of the correlation coefficient indicates the strength of the association.

Table 4.2: Correlation Analysis Result

Covariance Analysis: Ordinary

Sample: 1 120

Included observations: 120

Correlation Probability	ROA	AI	SCT	FG
ROA	1.000000			

AI	-0.109272	1.000000		
	0.2348	---------		
SCT	0.182497	0.125046	1.000000	
	0.0460	0.1736	----------	
FG	0.303584	0.180692	0.452215	1.000000
	0.0007	0.0483	0.0000	----------

Source: Researcher Computation (2024)

The Correlation matrix measures of associations between the variables. Table 2 shows the correlation coefficient (r) and the respective probabilities of the relationship between Artificial intelligence (AI) and supply chain technology (SCT) and financial performance variables (Return on assets), while using Firm growth (FG) as a control variable. Generally, a high correlation is expected between the dependent and independent variable while a low correlation is expected among the independent variables. The table revealed that there is a negative correlation and insignificant relationship between ROA and AI, but there is a positive correlation and significant relationship between ROA and the other variables (SCT and FG). It can also be seen that all the correlation coefficients of the independent variables are below 0.80, this points 6 to the absence of the problem of multicollinearity among the independent variables.

4.3 Variance Inflation Factor

Variance Inflation Factors
Date: 10/20/24 Time: 17:46
Sample: 2009 2023
Included observations: 120

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
AI	0.003606	3.895185	1.056518
SCT	0.008241	3.001273	1.145991
FG	0.000268	29.47184	1.091401
C	0.013133	30.20997	NA

Source: Researcher Computation (2024)

Decision rule: Centered VIF of less than 10 is an indication of absence of multicollinearity, while a centered VIF of more than 10 is an indication of presence of multicollinearity.

The multicollinearity result therefore indicates that the independent variables has no collinearity problem given that all the independent variables (AI, SCT and FG) have a centered VIF between 1 and 10.

4.4 Heteroskedasticity Test

Panel Cross-section Heteroskedasticity LR Test
Equation: UNTITLED
Specification:
Null hypothesis: Residuals are homoskedastic

	Value	Df	probability
Likelihood ratio	154.9137	8	0.0788
LR Test summary:	Value	Df	
Restricted LogL	-528.5087	116	
Unrestricted LogL	-451.0518	116	

Source: Researcher Computation (2024)

Table 4.4 above shows the results of the panel cross section heteroskedasticity regression test. The decision rule for the panel cross section heteroskedasticity test is stated thus:
H_0: No conditional Heteroskedasticity (residuals are homoscedastic)
H_1: There is conditional Heteroskedasticity
The null hypothesis is to be accepted if the P value is greater than 5% level of significance. From the results above, with a probability value of 0.0788, the study therefore posits that there is no reason to reject the null hypothesis while the alternative hypothesis that states that there is conditional heteroskedasticity is rejected. Consequently, based on the diagnostic probability, the null hypothesis is accepted thus there is no conditional Heteroskedasticity indicating that the residuals are homoscedastic and as such the samples give a true reflection of the population.

4.5 Hausman Specification Test

The Hausman specification test is a test for model specification in panel data analysis and this test is employed to choose between fixed effects model and rando m effects model. Due to the 10-panel nature of the data set, both fixed and random regressions were run. The Hausman 11 specification test was then conducted to choose the preferred model. This basically checked if the error terms were correlated with the regressors. The decision rule for the Hausman test is stated thus; at 5%level of significance,

H_0: Random effect is more appropriate for the panel regression analysis

H_1: Fixed effect is more appropriate for the panel regression analysis

Table 4.5: Hausman Specification Test Results

Correlation Random Effects – Hausman Test

Equation: Untitled

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	chi-Sq. d.f.	Prob.
Cross-section random	1.851779	3	0.6037

Source: Researcher Computation (2024)

The result of the Hausman test shows that the chi-square statistics value is 1.851779 while the probability value is 0.6037. This implies that a there is no reason to reject the null hypothesis which states that the random effect is most appropriate for the panel regression analysis. It thus stands that error component model (random effect) estimators is the most appropriate because the random effects are well correlated with the regressors.

4.6 Lagranger Multiplier Test (Test between Random and Pooled)

Hypothesis

H_0: Pooled effect is most appropriate for the panel regression analysis

H_1: Random effect is most appropriate for the panel regression analysis

As encapsulated above, if the p-value is less than 0.5, the decision rule is to reject the null hypothesis which states that pooled effect is most appropriate for the panel regression analysis (meaning that the preferred model is the random effects). Similarly, if the p-value is greater than 0.05, the decision rule is to reject the alternative hypothesis which states that random effects is most appropriate for the panel regression analysis.

Table 4.6: Breusch-Pagan Lagrange Multiplier Test

Residual Cross-Section Dependence Test
Null Hypothesis: No cross-section dependence (correlation) in Residuals
Equation: Untitled
Periods included: 15
Cross-sections included: 8
Total Panel (balanced) Observation: 120
Note: non-zero cross-section means detected in data
Cross-sections means were removed during computation of correlations.

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	65.91715	55	0.0148

Source: Researcher Computation (2024)

Based on the probability value of the Breusch-Pagan Lagrange Multiplier test at 0.0148, the null hypothesis, which states that pooled effect is most appropriate is rejected, thus the random effect model is most appropriate for the regression analysis.

4.7 Test of Research Hypothesis

Dependent Variable: ROA
Method: Panel EGLS (Cross-section random effects)
Sample: 2009 2023
Periods included: 15
Cross-sections included: 8
Total panel (balanced) observations: 120
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-45.03555	18.59703	-2.421653	0.0170
AI	7.992696	3.723314	2.146662	0.0339
SCT	0.000178	0.000345	0.514582	0.6078
FG	2.144401	0.824865	2.599699	0.0105
	Effects Specification			
			S.D.	Rho
Cross-section random			5.775390	0.0795
Idiosyncratic random			19.65007	0.9205
	Weighted Statistics			
R-squared	0.794559	Mean dependent var		-0.236405
Adjusted R-squared	0.761660	S.D. dependent var		20.33655
S.E. of regression	19.54674	Sum squared resid		44320.71
F-statistic	4.270338	Durbin-Watson stat		1.941232

Prob(F-statistic)	0.006718

Source: Researcher Computation (2024)

From the table 4.4 above, the coefficient of multiple regression (R^2) is 0.794559 and in line with the panel data used in this study, the regression model shows that the range of values between adjusted R^2 and R^2 falls between 79% and 76% respectively. This indicates that 79% of the total variations in financial performance is explained by the variations in the independent variables (AI, SCT, FG) similarly, from the result above, the coefficient of the intercept (for the random effect result) is negative and this indicates that at any point in time when the explanatory variables are held constant, financial performance does not improve but rather decreases by -45. In terms of residual test, the model is free from serial correlation as revealed by the Durbin Watson statistic of 1.94 which is within the acceptable range of 1.7 to 2.7.

The result therefore indicates that AI has a positive and significant effect on ROA as indicated by the p-value of 0.0339 which is less than the 5% significant level. Similarly, SCT shows a positive and insignificant effect on ROA as indicated by the p-value of 0.6078 which is greater than the 5% significant. The control variable of the study shows a positive and significant effect on return on assets, because it has a p-value of 0.0105 which is less than 5% level of confidence.

4.8 Discussion of Findings

This study seeks to investigate the effect of artificial intelligence and supply chain technology on the financial performance of listed ICT companies in Nigeria. Financial performance was measured using return on assets, and a control variable of firm growth was also included. It can be deduced from the results in Table 4.6 above that artificial intelligence has a positive and significant effect on financial performance of listed ICT firms in Nigeria. This means that with the involvement of AI in business processes, there will be a simultaneous increase in financial performance. This finding agrees with the findings of Shiyyab, Abdallah, Qais and Hashem (2023) where the study results, indicates that AI has a positive effect on accounting performance in terms of ROA and ROE. The study also depicts a positive and insignificant relationship between Supply chain technology and financial performance of listed ICT firms in Nigeria. This means that the effect of a change in SCT, does not cause a significant change to financial performance. This is in line with Amole, Adebiyi and Oyenuga (2021) which revealed without the implementing the key factors of supply chain there would not be a significant improvement in the performance of the organisation, but this is inconsistent with the findings of (Nweke, 2017) that concludes that supply chain management practices play an important role in return on investment significantly.

5. CONCLUSION AND RECOMMENDATIONS

From the result of the study, it can be concluded that increase in artificial intelligence will improve financial performance based on the statistical evidence while changes in supply chain management will have no

statistical influence on ICT firms. This means that supply chain technology is not strong enough to influence financial performance in listed ICT firms in Nigeria.

The following recommendations are therefore made:

i. The use of artificial intelligence in information and communication technology firms in Nigeria should be Encouraged because it has significant positive effect on financial performance of these firms.

ii. Regarding supply chain technology, a one-size-fit-all approach may not yield significant benefits, therefore, customization and process optimization can make these technologies more impactful.

References

Abidde, M. O. (2021) Cloud Computer Based Accounting and Corporate Financial Performance: A Study of Some Listed Manufacturing Companies in Nigeria*. IOSR Journal of Business and Management*, *23*(3) 12-19 DOI: 10.9790/487X-2303011219.

Adebayo, M. A., & Olorunfemi, S. (2022). Impact of artificial intelligence on revenue generation in Nigerian ICT firms. *Journal of Technology Management*, 12(3), 45-59.

Adebayo, M. (2024). Challenges in AI adoption for ICT firms in Nigeria: A cost-benefit analysis. *Nigerian Business Review*, 14(2), 21-34.

Agboola, O.O., & Agboola A.O. (2024). Influence Of Adoption Of Industry 4.0 On Insurance Companies Profitability In Nigeria. *Mediterranean Publication and Research International Journal, 4*(7), 60-70.

Akinboade A.A., (2020). Impact of ICT Usage on Financial Performance of Quoted Manufacturing Companies in Lagos State, Nigeria. *African Journal of Computing & ICT, 13*(2), 28 – 42. P-ISSN 2006-1781

Al Humdan, E, Shi, Y, Behina, M, Chowdhury, M.A, & Shakil Mahmud, A.K.M, (2022). The role of innovativeness and supply chain agility in the Australian service industry: a dynamic capability perspective*. International Journal of Physical Distribution & Logistics Management, 53*(11), 1-25, DOI 10.1108/IJPDLM-03-2022-006.

Aminu, I. M., & Shariff, M. N. (2015). Determinants of SMES performance in Nigeria: A pilot study. *Mediterranean Journal of Social Sciences*, *6*(1), 156-157

Amole, B.B. , Adebiyi, S.O & Oyenuga , O.G.(2021). Logistics, supply chain, sustainability and global challenges Vol. 12, Iss. 1, December 2021, 17-30 doi: 10.2478/jlst-20210002 17 Multi-Criteria Decision Analysis of Supply Chain Practices and Firms Performance in Nigeria

Anajaa E.O.& , Bagobiri, E. Y. (2022). Effect of Supply Chain Management on Organizational Performance of Selected Fast Moving Consumer Good In Karu, Nigeria. *International Journal of Research Publications108*(1), 145-168. doi:.10.47119/IJRP1001081920223856

Boyte-White, C., (2022). *How to calculate return on assets with examples*. Investopedia. https://www.investopedia.com/ask/answers/031215/what-formula-calculatingreturn-assets-roa.asp

Davidsson, P., & Wiklund, J. (2019). Levels of analysis in entrepreneurship research: Current research practice and suggestions for the future. *Entrepreneurship Theory and Practice, 43*(1), 3-18.

Didia J. U., Gladson N., (2015). Supply Chain Integration and Business Performance in the Telecommunication Industry in Nigeria. *International Journal Supply Chain Management*, *4*(2), 81-89.

Effiong, S. A., & Ejabu, F. E. (2020). Liquidity risk management and financial performance: are consumer goods companies involved?. *International Journal of Recent Technology and Engineering, 9*(1), 580 – 589.

Ezechukwu, B., Amahalu, N.N., & Okudo, C.L., (2022). National Information Technology Development Levy and Financial Performance of Telecommunication Companies in Nigeria. *International Journal of Business Marketing and Management (IJBMM) 7*(5), P.P. 77-84. ISSN: 2456-4559 www.ijbmm.

Ezechukwu, B.O., & Amahalu, N.N. (2019, September 23-26*). Effect of corporate governance mechanism on financial performance of quoted agricultural firms in Nigeria*. 2nd National Conference Academic Staff Union of Polytechnics (ASUP), Federal Polytechnic Oko, Nigeria

Eze, T. A., & Onu, G. (2023). Supply chain technology and financial performance: Evidence from Nigerian ICT firms. *Journal of Supply Chain Management*, 15(4), 80-95.

Ezekiel O., (2018). Impact of Disruptive Technology on The Performance Of Insurance Firms In Kenya. *Journal of Strategic Management*, *3*(1), 72- 82. ISSN 25200461(Online)

Ezeribe, C. (2019). Artificial Intelligence (AI) and the Accountancy Profession : The Threats of Obsolescence (Issue November, p. 54).

Finkenwirth, K. (2021) The impact of artificial intelligence on financial performance in the German financial service industry – a content analysis

Giroud, X., & Muller, H. M. (2017).Firm leverage, customer demand and employment losses during the great recession. The quarterly journal of economics, 132(1), 271-316.

Hang, C. C., & Yu, D., (2010). A reflective review of disruptive innovation theory. *International Journal of Management Reviews, 12*(4), 435-452

Hill, C. W., & Rothaermel, F. T. (2003). The performance of incumbent firms in the face of radical technological innovation. *Academy of Management Review, 28*(2), 257274.

Kok, J., Boers, E., Kosters, W. A., Putten, P. Van Der, & Poel, M. (2010). *Artificial Intelligence: Definition, Trends, Techniques and Cases*. Encyclopedia of Life Support Systems (EOLSS). https://www.eolss.net/Sample-Chapters/C15/E6-44.pdf

Lee, R., (2021). The Effect of Supply Chain Management Strategy on Operational and Financial Performance Sustainability, *1*(3), 5138. https://doi.org/10.3390/ su13095138

Nasamu G., (2020). Effects of Technology Innovation on Financial Performance of Commercial Banks in Nigeria. *Journal of Management Science & Entrepreneurship JMSE, 20* (7)*,* ISSN – 2370-9878

Nnamdi, I., & Chigozie, A. (2022). The role of blockchain in enhancing supply chain performance in Nigerian ICT firms. *International Journal of Digital Technology*, 8(3), 30- 42.

Nurudeen, S. A., Oyerinde, A. J., Tella. R.A. , Oloyede, L.R. , & Michael, A.A. (2024). Assessment of Technological Innovations on Supply Chain Management of Some Selected SMES in Lagos State*. International Journal of Research Publication and Reviews, 5(*6) 6938-6946

Nweke, B. O. (2017) Impact of supply chain management on the financial performance of listed soft drink manufacturing companies in Enugu, south east Nigeria: a value chain perspective. *International Journal of Marketing and Management Research* 8(8)

Ogomegbuna, A.O. (2023). Exploring the effect of supply chain management practices on manufacturing firms' performance in Delta state, Nigeria. *International Journal of Management & Entrepreneurship Research 5(*1) 68-84, DOI: 10.51594/ijmer.v5i1.438

Okafor, A. S., Oke, M. I., & Chukwu, O. P. (2021). Impact of supply chain technologies on the financial performance of Nigerian ICT firms. *Journal of Logistics and Technology,* 10(1), 12-24.

Okoro, U., & Nwachukwu, E. (2023). Artificial intelligence and customer engagement in Nigerian ICT firms: A study of financial outcomes. *Journal of Marketing Technology*, 6(2), 71-84.

Otti, O.S; Udeh, F.N., Amahalu, N.N., Obi, J.C. (2022). Effect of value engineering on profitability of quoted manufacturing firms in Nigeria. *International Journal of Management Studies and Social Science Research, 4*(1), 60-76.

Pavaloaia, V.D., & Necula, S.C.,(2023). Artificial Intelligence as a Disruptive Technology—A Systematic Literature Review. Electronics 12, 1102. https:// doi.org/10.3390/electronics12051102

Ransbotham, H. J. L. H., Mitra, S., & Goh, J. (2021). The impact of artificial intelligence on business performance: A review and research agenda. *Journal of Business Research*, 124, 97-112.

Roberta, B. S., (2019). 4 Elements in Securing the Telecommunications Supply Chain. Cybersecurity EngineeringZainal, 2021

Schumpeter (1942)

Security scorecard, (2023) *What is the ICT Supply Chain? Things Your Business Needs to Know.* Security Scorecard. https://securityscorecard.com.

Serge-Lopez W., Samuel F. W., Jean R.k., & Chris E.T., (2020). Influence of Artificial Intelligence (AI) on Firm Performance: The Business Value of AI-based Transformation Projects. *Business Process Management Journal*. DOI: 10.1108/BPMJ-10-2019-0411

Shiyyab, F. S, Abdallah B. A, Qais M. O., & Hashem A (2023). The Impact of Artificial Intelligence Disclosure on Financial Performance. *International Journal of Financial Studies* 11: 115. https://doi.org/10.3390/ ijfs11030115

Smadi, T. Al, Al Issa, H., Trad, E., & Smadi, K. Al. (2015). Artificial Intelligence for Speech Recognition Based on Neural Networks. *Journal of Signal and Information Processing, 06*(02), 66–72.

Soni, N., Sharma, E,K., Singh, N., & Kapoor, A. (2018). Impact of artificial intelligence on business. Paper presented at the University of Delhi, Delhi, India. Retrieved from http://www.researchgate.net/publication/325644986-impact-ofArtificialIntelligence-on-Business,pdf

Sunday A.E., Fadenipo A.A., Okoi, J.O., & Nwafor C.B., (2021). Applicability Synergy of Disruptive Technology And Financial Performance of Pharmaceutical Companies. *Turkish Online Journal of Qualitative Inquiry (TOJQI) 12*(8),6618 – 6630.

Tamplin, T., (2022). *Return on assets*. Finance Strategists. https://learn.financestrategists.com/finance-terms/return-onassets-ratio-definition-and-formula/

Wehle, H. (2017). ML – AI- COGNITIVE (Issue July).