Artificial Intelligence in Accounting and Firm Effectiveness Among Manufacturing Companies in Nigeria

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Abstract

The study examined the influence of Artificial Intelligence in Accounting on firm effectiveness among manufacturing companies in Nigeria. The specific objective was to assess the influence of machine learning automation and robotic process automation on firm effectiveness of manufacturing companies in Nigeria. This study employed a descriptive survey design. The study targeted staff that work in manufacturing companies in Nigeria. Cochran's formula for determining sample size was employed to calculate the required sample size of 271 respondents from manufacturing companies across Nigeria. Primary data for the study were collected using structured questionnaire administered on the respondents. . Descriptive analysis technique, including frequency distribution, was used to summarize the research questions and present an overview of the respondents' perspectives. Spearman Ranked Order correlation was employed to test the hypotheses. The findings showed that: Machine Learning Automation has a positive influence on the firm effectiveness of manufacturing companies in Nigeria (Correlation Coefficient = 0.586, p-value = 0.000); Robotic Process Automation has a positive influence on the firm effectiveness of manufacturing companies in Nigeria (Correlation Coefficient = 0.504, p-value = 0.000). In conclusion, firms boost their performance and competitiveness by integrating these advanced automation technologies which offer a promising avenue for achieving operational excellence and sustained growth. Therefore, the study recommends that Operations Managers and Accounting Department Heads should deploy Robotic Process Automation tools to automate repetitive tasks such as data entry and transaction processing in order to reduce manual errors, increase efficiency, and allow employees to focus on more strategic activities, thereby enhancing firm effectiveness.

Keywords: *Artificial Intelligence, Machine Learning Automation, Robotic Process Automation, Firm Effectiveness*

1.0 Introduction

In recent years, the business environment has undergone significant transformations, largely driven by technological advancements. One of the most notable areas of change has been the integration of Artificial Intelligence (AI) into various business functions. More also, firms, which are heavily reliant on efficient financial operations, have begun incorporating AI-powered tools to streamline their accounting processes and improve decision-making (Wang, Huang, Xia, & Shi, 2024). Ifekanandu, Ezirim, and Kingsley (2023) argued that the evolution of digital technologies, particularly AI, has created new opportunities for organizations to enhance their operational effectiveness and achieve competitive advantages. The advent of AI technologies has revolutionized the way companies manage their financial operations, allowing for automation of repetitive tasks, faster data processing, and more accurate financial reporting. AI tools have the capability to analyze large datasets in real-time, identify patterns, and provide insights that human accountants may overlook (Badghish & Soomro, 2024).

In a competitive business domain where time and accuracy are critical, AI offers the advantage of speed and precision, which is crucial for firms looking to optimize their accounting practices (Chukwuemeka-Onuzulike, 2023). This is particularly important for manufacturing companies, where efficient accounting systems are essential for tracking production costs, managing inventory, and ensuring financial transparency. With AI, tasks such as invoice processing, expense tracking, and financial forecasting can be completed with greater efficiency, allowing firms to allocate resources more effectively and focus on strategic growth initiatives. As global business trends move toward increased automation and data-driven decision-making (Idu, Onodi & Nwosu, 2022), Nigerian manufacturing firms must embrace AI in accounting to stay competitive.

Artificial Intelligence in accounting involves the use of advanced algorithms, machine learning, and automation tools to perform various accounting tasks that were traditionally handled by human accountants (Mmadubuobi, Nworie & Aziekwe, 2024; Khaled AlKoheji & Al-Sartawi, 2022). AI accounting systems also have the ability to provide real-time updates, offering firms a more dynamic and responsive financial management system (Hasan, 2021). These technologies help in minimizing human error, and reducing operational costs, which are crucial for the sustainability of manufacturing companies (Idu, Onodi & Nwosu, 2022). The adoption of AI in accounting has had a profound effect on the effectiveness of firms, particularly in the manufacturing sector since AI usage enhances decision-making. AI-driven accounting systems can process vast amounts of financial data in real-time, providing management with actionable insights that are based on accurate and up-to-date information (Wang, Huang, Xia, & Shi, 2024). This allows companies to make informed decisions regarding investments, cost management, and resource allocation. Additionally, AI tools help in improving the accuracy of financial reporting, which is essential for maintaining stakeholder trust and complying with regulatory requirements. Accurate financial records not only ensure transparency but also allow firms to detect and rectify issues such as fraud or discrepancies in their accounts more quickly. Moreover, AI contributes to firm effectiveness by automating routine tasks, which reduces the likelihood of human error, decreases operational costs, and allows firms to reallocate human resources to more strategic roles (Ifekanandu, Ezirim & Kingsley, 2023).

However, despite the advancements in AI technology, many firms still rely heavily on traditional accounting methods that are labor-intensive, prone to human error, and inefficient

in handling large volumes of financial data (Badghish & Soomro, 2024). The slow adoption of AI in accounting among Nigerian manufacturing firms has resulted in delayed financial reporting, inaccurate data processing, and poor decision-making. Additionally, the lack of skilled personnel and resources to implement and manage AI-powered accounting systems further exacerbates the problem, leaving firms vulnerable to operational inefficiencies, fraud, and regulatory compliance issues.

The consequences of this situation are significant. Manufacturing companies that fail to integrate AI into their accounting practices face increased operational costs, reduced competitiveness, and a higher likelihood of financial mismanagement. The reliance on outdated accounting systems can lead to missed opportunities for cost savings, inaccurate financial forecasting, and poor strategic decision-making. As a result, the overall effectiveness of these firms is compromised, limiting their ability to achieve sustainable growth and compete in an increasingly digital and automated global marketplace. Even though a number of related studies such as Badghish and Soomro (2024); Wang, Huang, Xia, and Shi (2024); Ifekanandu, Ezirim, and Kingsley (2023); Chukwuemeka-Onuzulike (2023); Idu, Onodi, and Nwosu (2022); Hashem and Alqatamin (2021); Elegunde and Oladimeji (2020) have been carried out in the past, there is still a glaring lack of studies that specifically assessed the relationship between artificial intelligence in accounting and firm effectiveness among manufacturing companies in Nigeria, hence the need for this study to address the gap in literature.

Objective of the Study

The main objective of the study is to examine how Artificial Intelligence in Accounting influences firm effectiveness among manufacturing companies in Nigeria. The specific objective is to assess:

1) The influence of machine learning automation on firm effectiveness of manufacturing companies in Nigeria.

2) The Influence of Robotic Process Automation on firm effectiveness of manufacturing companies in Nigeria.

Hypotheses of the Study

H01) Machine learning automation has no significant influence on firm effectiveness of manufacturing companies in Nigeria.

H02) Robotic Process Automation has no significant influence on firm effectiveness of manufacturing companies in Nigeria.

2.0 Literature Review

2.1 Conceptual Review

Artificial Intelligence

Artificial Intelligence (AI) is a branch of computer science focused on the creation of systems capable of performing tasks that would normally require human intelligence (Badghish & Soomro, 2024). These tasks include but are not limited to problem-solving, decision-making,

understanding language, recognizing patterns, and learning from experience. AI systems are designed to simulate human cognitive processes through the use of algorithms and computational models, enabling machines to "think" and "learn" in ways similar to the human brain. The primary goal of AI is to develop intelligent systems that can operate autonomously, meaning they can make decisions and perform actions without continuous human input or oversight (Chukwuemeka-Onuzulike, 2023). AI technology has been employed across various sectors, from healthcare and finance to manufacturing and marketing, to improve efficiency and accuracy in tasks that were previously reliant on human intervention (Wang, Huang, Xia, & Shi, 2024).

AI operates on the foundation of several key components such as perception, reasoning, and learning. Through perception, AI systems gather data from their surroundings via sensors or inputs, such as visual or auditory signals, and then process that data in a meaningful way. Reasoning is the process through which AI makes decisions based on the information it has acquired, applying logic or pre-programmed rules to reach a conclusion (Mmadubuobi, Nworie & Aziekwe, 2024). Learning, particularly in the context of machine learning, allows AI systems to improve their performance over time by analyzing past actions and outcomes, adjusting their algorithms accordingly to achieve better results in future scenarios (Hashem & Alqatamin, 2021). This learning capability is what distinguishes AI from traditional software, as it enables systems to adapt and refine their behavior without the need for constant programming updates.

The application of AI spans a wide range of industries and fields, with each application focusing on improving operational efficiency, decision-making, and the quality of outcomes (Elegunde & Oladimeji, 2020). For example, in the healthcare sector, AI is used to assist in diagnosing diseases by analyzing medical images and patient data more quickly and accurately than human doctors might. In finance, AI algorithms help in detecting fraud, predicting market trends, and automating customer service operations (Hashem & Alqatamin, 2021). AI's ability to process massive amounts of data in real time has proven indispensable in industries where quick and accurate decisions are critical. As AI technology continues to evolve, its role in driving automation, enhancing productivity, and solving complex problems will become even more pervasive (Badghish & Soomro, 2024).

Machine Learning Automation

Machine Learning (ML) automation refers to the process by which algorithms and statistical models are employed to allow machines to learn from data without being explicitly programmed for every task (Mahesh, 2020). Machine learning automation enables systems to identify patterns, make predictions, and continuously improve their performance as they are exposed to more data. This capacity for learning and adaptation distinguishes machine learning from traditional forms of automation, which are based on rigid, pre-defined rules. Machine learning relies on historical data to train models, and once these models are trained, they can automatically apply the learned knowledge to new, unseen data. Over time, machine learning algorithms refine their accuracy, becoming more reliable in performing their designated tasks (Zhou, 2021).

The primary benefit of machine learning automation is its ability to handle vast datasets and complex tasks that would be infeasible for humans to process manually (Pap, Mako, Illessy, Kis & Mosavi, 2022). For example, in sectors such as finance and e-commerce, machine learning algorithms are used to detect fraud, personalize customer experiences, and optimize

marketing strategies by analyzing consumer behavior patterns in real-time. These systems can identify relationships within data that are not immediately apparent to human analysts, providing insights that lead to more informed decisions. Additionally, machine learning automation is particularly effective in predictive analytics, where it can forecast future outcomes based on historical data trends (Mahesh, 2020). This makes it invaluable in fields like healthcare, where predicting patient outcomes or disease outbreaks can have life-saving implications.

A critical aspect of machine learning automation is its iterative nature. When a machine learning model is first created, it is trained on a dataset to establish a baseline of understanding. As more data becomes available, the model automatically updates itself, continually refining its predictions and performance. This ability to evolve with new data is what gives machine learning automation its power—rather than being static, the system improves over time, reducing errors and increasing accuracy (Pap, Mako, Illessy, Kis & Mosavi, 2022). This is especially important in dynamic environments where conditions change frequently, as machine learning models can adapt without requiring manual reprogramming. For instance, self-driving cars rely on machine learning automation to recognize objects, predict traffic patterns, and adjust their driving behavior based on constantly changing road conditions.

Robotic Process Automation

Robotic Process Automation (RPA) refers to the use of software robots, or "bots," to automate repetitive and rule-based tasks that were traditionally performed by humans (Durão & dos Reis, 2024). These tasks often involve routine activities such as data entry, invoice processing, generating reports, or interacting with multiple systems to transfer data. RPA mimics human interactions with digital systems, using predefined rules and logic to complete tasks faster, more accurately, and without fatigue. Unlike traditional automation systems, which often require complex coding and integration with existing software, RPA can be deployed quickly, leveraging the existing IT infrastructure to perform tasks with minimal disruption to business processes.

The primary advantage of RPA is its ability to improve operational efficiency by reducing the time, effort, and errors associated with manual tasks (Hofmann, Samp & Urbach, 2020). By automating these routine processes, businesses can free up their human workforce to focus on more strategic and value-adding activities, such as decision-making, customer service, and innovation. In industries like finance, healthcare, and manufacturing, RPA has become a valuable tool for handling high-volume transactions, managing compliance requirements, and maintaining accuracy in financial reporting. For example, an RPA bot might be programmed to automatically process customer orders, validate financial transactions, or update inventory levels, all without human intervention. As a result, companies can scale their operations more easily, respond faster to market changes, and reduce the risk of human error.

RPA operates on a set of rules and logic, meaning that it is most effective in environments where processes are clearly defined and standardized (Durão & dos Reis, 2024). It is not designed to handle tasks that require judgment, creativity, or problem-solving—those areas are better suited for more advanced forms of AI or human intervention. However, within its scope, RPA excels at handling repetitive, high-volume tasks with precision and speed. It also integrates well with other technologies, such as machine learning and AI, to create more sophisticated automation systems.

Firm Effectiveness

Firm effectiveness refers to the ability of an organization to achieve its goals and objectives in an efficient and sustainable manner (Lasisi, Shodiya & Raji, 2014). It is a measure of how well a firm utilizes its resources—such as capital, labor, technology, and time—to deliver value to its stakeholders, including customers, employees, shareholders, and the broader community. Firm effectiveness is typically evaluated based on several key performance indicators (KPIs), including profitability, market share, customer satisfaction, innovation, and operational efficiency. A firm that is considered effective not only meets its financial targets but also adapts to changes in the external environment, such as shifts in market demand, technological advancements, and regulatory requirements (Akanbi, 2014).

An effective firm continua*l*ly seeks ways to streamline its operations, often through the adoption of new technologies, automation, and process improvement methodologies such as Lean or Six Sigma. By improving operational efficiency, firms can deliver goods and services faster, at lower costs, and with higher quality, giving them a competitive edge in the marketplace. Additionally, operational efficiency contributes to better resource allocation, ensuring that the firm is using its assets—both human and financial—effectively to maximize returns. Another critical aspect of firm effectiveness is its ability to innovate. In today's rapidly changing business landscape, firms that fail to innovate risk becoming obsolete. Effective firms are those that foster a culture of continuous improvement, encouraging creativity and experimentation to develop new products, services, and business models that meet evolving customer needs. Innovation is not limited to product development; it also includes process innovation, such as finding new ways to serve customers, improve supply chain management, or enhance employee productivity (Michael, Oluwafunmilayo & Oyedepo, 2023). By maintaining a focus on innovation, firms can remain competitive and adapt to changes in technology, market trends, and customer preferences.

2.2 Theoretical Framework

The Innovation Diffusion Theory (IDT) was first propounded by Everett Rogers in 1962. The theory originated in the fields of sociology and communication, and it seeks to explain how, why, and at what rate new ideas and technologies spread within a society or an organization (Seidu, Edwards, Owusu-Manu & Buertey, 2024). Rogers' work built on earlier research in rural sociology, which studied how agricultural innovations were adopted by farmers. His seminal work, *Diffusion of Innovations*, emphasized that innovations, whether technological or conceptual, follow a predictable pattern of adoption over time. The diffusion process begins with innovators, followed by early adopters, the early majority, the late majority, and finally the laggards. Rogers' theory highlights the role of communication channels, social systems, and time in the diffusion of an innovation, emphasizing that for any new technology or idea to be adopted, it must be perceived as better than the existing alternative (Yadegari, Mohammadi & Masoumi, 2024).

The main postulations of the Innovation Diffusion Theory revolve around several key concepts. First, the theory suggests that the rate of adoption of an innovation depends on its perceived attributes, which include relative advantage, compatibility, complexity, trialability, and observability (Menon & Sujatha, 2021). Relative advantage refers to how much better the innovation is compared to the current practice, while compatibility assesses how well the

innovation fits with the values, past experiences, and needs of the adopters. Complexity refers to how difficult the innovation is to understand and use, while trialability measures the degree to which an innovation can be experimented with before adoption. Lastly, observability is the extent to which the results of the innovation are visible to others. Additionally, Rogers' theory emphasizes the social system within which the innovation spreads, noting that peer influence, opinion leaders, and communication networks play critical roles in the adoption process. The theory also considers the decision-making process as a critical component of diffusion, typically involving knowledge acquisition, persuasion, decision, implementation, and confirmation stages.

In the context of the topic "Artificial Intelligence in Accounting and Firm Effectiveness Among Manufacturing Companies in Nigeria," the Innovation Diffusion Theory is highly relevant. The adoption of AI in accounting processes within manufacturing firms can be viewed as an innovation, and the diffusion of this technology is influenced by the perceived benefits it offers, such as enhanced accuracy, efficiency, and decision-making capabilities. AI in accounting provides a relative advantage by automating complex tasks, reducing human error, and enabling data-driven insights. Its compatibility with existing financial systems and regulatory environments also determines its uptake among Nigerian manufacturing companies. Moreover, the complexity of AI technologies may pose a challenge, requiring firms to invest in training and infrastructure to fully harness their potential. The theory's focus on communication channels and social influence is also applicable, as firms are likely to adopt AI more rapidly when they observe successful implementation by industry leaders or competitors. Thus, the diffusion of AI in accounting aligns with the postulations of the Innovation Diffusion Theory, offering insights into how and why firms adopt new technologies to improve their effectiveness.

2.3 Empirical Review

Badghish and Soomro (2024) developed a theoretical model to identify the key factors influencing the adoption of Artificial Intelligence (AI) by small and medium-sized enterprises (SMEs) for sustainable business performance in Saudi Arabia, using the Technology–Organization–Environment (TOE) framework. The study applied a quantitative method, using a survey distributed to managers from six different sectors. Data were analyzed with SmartPLS 3, and multi-group analysis was used to explore differences between small and medium-sized businesses. Firm size moderated the relationships in the model, with medium-sized firms showing a stronger link between relative advantage and AI adoption than small firms. The study concluded that factors such as compatibility, sustainable human capital, market demand, and government support play key roles in AI adoption, which, in turn, improves SMEs' operational and economic performance. These findings provide practical insights for firms on how to leverage AI to enhance sustainable business performance.

Wang, Huang, Xia, and Shi (2024) investigated whether Artificial Intelligence enhances firms' innovation efficiency, using data from the International Federation of Robotics (IFR) and detailed records of Chinese manufacturing firms between 2015 and 2019. The researchers employed Data Envelopment Analysis (DEA) to measure innovation efficiency and used the Tobit model to assess AI's impact on this efficiency. The study explored the heterogeneity of AI's influence across different types of firm ownership, industries, and regions and examined the mechanisms by which AI affects innovation. The results indicated that AI application

significantly boosts firms' innovation efficiency, findings that were robust even when alternative AI proxies and instrumental variable regressions were used. The most notable effects were observed in state-owned enterprises, traditional manufacturing industries, and developed cities. Further analyses revealed that AI adoption reshapes human capital, innovation models, and the market environment, thereby improving innovation efficiency.

Ifekanandu, Ezirim, and Kingsley (2023) examined the adoption of Artificial Intelligence and its impact on the marketing performance of listed manufacturing firms in Nigeria. The study used a correlational research design and surveyed 206 managers from 71 quoted manufacturing firms, selected using Taro Yamene's formula. The data, collected through structured questionnaires, were analyzed using Spearman's Rank Order Correlation Coefficient. The findings revealed that AI technologies significantly improve the sales growth and market share of manufacturing firms. Additionally, AI capabilities were found to have a strong and positive impact on marketing performance, particularly in terms of sales growth and market share expansion.

Chukwuemeka-Onuzulike (2023) investigated the influence of Artificial Intelligence on the growth of SMEs in Anambra State. A survey research design was adopted, with a population and sample size of 50 SME operators. The study used a structured questionnaire and employed regression analysis to test the hypotheses. The results indicated that 21% of the variation in business model design (BMD) in SMEs was attributable to AI adoption, suggesting a positive and strong relationship between AI and BMD. The study concluded that AI significantly impacts SME business model design, recommending that SME operators adopt AI to improve efficiency, effectiveness, and productivity while reducing operational costs.

Idu, Onodi, and Nwosu (2022) explored the relationship between Artificial Intelligence and business sustainability in Sub-Saharan Africa. Using an ex-post facto research design, the study analyzed secondary data from the annual reports of selected multinational firms from 2013 to 2022. The results showed that AI had no significant effect on the economic reporting of these firms but had a significant impact on their environmental reporting. The researchers recommended that firms in Sub-Saharan Africa adopt AI-specific measures to address climate change by sharing best practices and supporting innovative AI applications.

Hashem and Alqatamin (2021) investigated the impact of Artificial Intelligence on the efficiency of accounting information systems (AIS) and non-financial performance standards in Jordan's industrial sector. A quantitative approach was used, with data collected from 409 managers, department heads, and accountants through an electronic survey. Analysis using SPSS showed that AI significantly enhanced the efficiency of AIS by improving the reliability, understandability, and comparability of outputs. Additionally, AI was found to positively influence non-financial performance by helping firms identify weaknesses and leverage strengths. The study recommended better integration of AI into AIS and alignment with organizational goals.

Elegunde and Oladimeji (2020) assessed the role of Artificial Intelligence in enhancing business performance in Nigerian banks. A survey of 200 employees and customers of Access Bank Plc and UBA was conducted, with data analyzed using regression analysis. The findings demonstrated that AI positively impacted non-financial business measures such as customer satisfaction, service quality, competitive advantage, and employee efficiency. The study

supported previous research on AI's role in achieving business objectives, with significant variation explained by AI in the sampled variables.

3.0 Methodology

This study employed a descriptive survey design, which is ideal for research that seeks to describe or characterize a specific phenomenon by profiling the opinions, perceptions, or behaviors of a group of individuals or entities. In the context of this study, the focus was on examining the relationship between Artificial Intelligence (AI) in accounting and firm effectiveness among manufacturing companies in Nigeria. Descriptive research is particularly appropriate for this type of investigation, as it allows for the systematic collection and analysis of respondents' opinions regarding how AI in accounting influences the operational efficiency and overall effectiveness of their firms. By gathering detailed information from a representative sample, the study aimed to provide a comprehensive overview of how AI adoption is transforming the accounting functions of manufacturing firms.

The study targeted manufacturing companies in Nigeria, a sector with significant potential for AI-driven innovation but with varying levels of technological adoption. However, due to the absence of a comprehensive database or registry detailing the exact number of staff of manufacturing firms in the country, the study adopted an infinite population approach to define its target population. Given that the true proportion of staff working in manufacturing companies utilizing AI in accounting is unknown, the study assumed an estimated proportion of 50%, which provides a conservative estimate for sample size determination. Cochran's formula for determining sample size was employed to calculate the required sample size for an infinite population.

The formula for sample size determination is as follows:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

Where:

n_0 = Sample size for an infinite population

Z = Z-value

p = Estimated proportion of the population (if unknown, 0.5 is used as it maximizes the sample size)

e = Desired level of precision (10%)

Z-value value for a 90% confidence level is 1.645.

Thus,

$$n = \frac{(1.645)^2 \ X \ 0.5 \ X \ 0.5}{(0.05)^2}$$

Approximately, n = 271

Thus, the calculated sample size was approximately 271 respondents from manufacturing companies across Nigeria.

Primary data for the study were collected from a sample of 271 respondents from manufacturing companies in Nigeria using a structured questionnaire. The questionnaire was meticulously designed to gather comprehensive information on how Artificial Intelligence in accounting impacts firm effectiveness. It included closed-ended questions to generate quantitative data, structured according to a five-point Likert scale. This scale ranged from "Strongly Agree" to "Strongly Disagree," allowing respondents to express their level of agreement with various statements regarding the influence of AI on accounting practices, operational efficiency, decision-making, and overall firm performance.

The questionnaires were distributed using a random sampling technique, with respondents selected from various manufacturing sectors across Nigeria. To facilitate data collection, online surveys were employed, ensuring broader reach and quicker response times. After collection, the data were processed and analyzed using SPSS Version 26 statistical software. Descriptive analysis techniques, including frequency distribution, were used to summarize the research questions and present an overview of the respondents' perspectives.

Inferential analysis was also conducted to test the study's hypotheses. Specifically, the Spearman Ranked Order correlation was employed to test the hypotheses. This method is suitable for assessing the strength and direction of the association between two variables when the data is ordinal or not normally distributed. The hypotheses were tested at a 5% significance level, with the null hypothesis being rejected in favour of the alternative hypothesis if the P-value was less than 0.05. Conversely, if the P-value exceeded the significance level, the null hypothesis was accepted, and the alternative hypothesis was rejected.

4.0 Data Analysis and Discussion

4.1 Analysis of Research Questions

Table 4.1 Analysis of Research Questions

S/N	Machine Learning Automation	SA	A	N	D	SD
1	Machine learning automation helps to identify accounting errors more quickly.	59	102	34	35	41
2	The use of machine learning automation has improved the accuracy of financial forecasting in our firm.	49	108	33	52	29

3	Implementation of machine learning automation has reduced manual tasks in accounting operations.	73	75	55	35	33
4	The integration of machine learning automation in our accounting system has improved overall data processing speed.	41	104	44	56	26
S/N	**Robotic Process Automation (RPA)**	**SA**	**A**	**N**	**D**	**SD**
5	Robotic process automation has considerably improved the efficiency of repetitive accounting tasks in our firm.	49	107	32	61	22
6	RPA implementation has reduced the time spent on data entry and other routine accounting functions.	133	34	40	17	47
7	Robotic process automation has improved the accuracy of our financial reporting.	58	105	50	38	20
8	RPA allows our accounting department to focus more on strategic financial analysis rather than routine tasks.	46	97	41	61	26
S/N	**Firm Effectiveness**	**SA**	**A**	**N**	**D**	**SD**
9	AI-driven accounting processes have enhanced our firm's ability to meet financial goals.	60	101	44	34	32
10	The use of AI in accounting has positively impacted our firm's financial performance.	77	78	42	48	26
11	Artificial intelligence has improved the quality of decision-making within our firm's accounting department.	41	122	53	35	20
12	AI technologies have contributed to increased cost-effectiveness in our firm's operations.	65	80	44	56	26

Source: Field Survey (2024)

The frequency table (Table 4.1) presents responses to questions on the impact of Machine Learning Automation (MLA), Robotic Process Automation (RPA), and Artificial Intelligence (AI) on firm effectiveness. Each item in the table reflects how respondents perceive the role of these technologies in enhancing accounting functions and overall firm performance.

The first item under machine learning automation shows that 59 respondents "strongly agree" and 102 "agree" that MLA helps to identify accounting errors more quickly, indicating that a significant portion of respondents recognize its value in error detection. However, 35 respondents "disagree" and 41 "strongly disagree," suggesting that some individuals may not have observed its full potential in their respective firms. This variation might be due to differences in the integration of MLA in their accounting processes.

In the second item, 49 respondents "strongly agree" and 108 "agree" that MLA has improved financial forecasting accuracy. This reinforces the perception that MLA is effective in predictive accounting functions. However, a notable 52 "disagree" with this statement, hinting at challenges in implementation or inconsistent results across different companies.

The third item reveals that a majority, with 73 respondents "strongly agreeing" and 75 "agreeing," believe MLA has reduced manual tasks in accounting operations, reflecting a positive impact on labor efficiency. Nonetheless, 33 "strongly disagree," pointing to firms where automation may not have effectively replaced manual processes.

Item four shows that MLA has improved data processing speed, as 41 respondents "strongly agree" and 104 "agree." However, with 56 "disagree" and 26 "strongly disagree," it's evident that not all firms experience significant improvements in this area, possibly due to technological or infrastructure constraints.

Regarding RPA, the first item in this category shows that 49 respondents "strongly agree" and 107 "agree" that RPA has improved the efficiency of repetitive accounting tasks. This indicates widespread recognition of RPA's role in streamlining routine activities, although 61 "disagree," suggesting that the perceived benefits might be unevenly distributed across firms.

In the second RPA item, an overwhelming 133 respondents "strongly agree" that RPA has reduced the time spent on data entry and routine accounting functions. This highlights RPA's impact on operational efficiency. However, 47 respondents "strongly disagree," showing that some firms may face challenges in realizing these benefits, perhaps due to incomplete implementation.

The third RPA item shows that 58 respondents "strongly agree" and 105 "agree" that RPA has improved the accuracy of financial reporting, which aligns with its expected role in minimizing human error. Yet, 38 respondents "disagree," signaling that some organizations may not have fully leveraged RPA's capabilities.

In the fourth RPA item, 46 respondents "strongly agree" and 97 "agree" that RPA allows the accounting department to focus more on strategic analysis. This implies a shift in the workload from routine to more value-added tasks. However, 61 "disagree," indicating that this shift is not universally experienced, possibly due to varying levels of RPA maturity.

The first item under firm effectiveness shows that 60 respondents "strongly agree" and 101 "agree" that AI-driven accounting processes have enhanced their firm's ability to meet financial goals. This suggests a strong belief in AI's contribution to achieving financial targets, although 34 "disagree" and 32 "strongly disagree," indicating that some firms may not yet see tangible results.

In the second item on firm effectiveness, 77 respondents "strongly agree" and 78 "agree" that AI has positively impacted their firm's financial performance. While this underscores AI's perceived value in boosting financial outcomes, 48 respondents "disagree," implying that challenges in implementation or integration might limit these benefits for some companies.

The third item reveals that 41 respondents "strongly agree" and 122 "agree" that AI has improved decision-making quality within the accounting department. This reflects widespread approval of AI's role in enhancing the decision-making process. However, 35 "disagree," suggesting that not all firms experience improved decision-making, possibly due to inadequate data integration or analysis.

Finally, in the last item, 65 respondents "strongly agree" and 80 "agree" that AI technologies have contributed to increased cost-effectiveness in their firm's operations. This shows AI's role in reducing operational costs, although 56 "disagree," highlighting that some firms may not have fully realized these cost benefits.

4.2 Test of Hypotheses

4.2.1 Test of Hypothesis I

H01) Machine learning automation has no significant influence on firm effectiveness of manufacturing companies in Nigeria.

Table 4.2 Test of Hypothesis I

			Firm Effectiveness
Spearman's rho	Machine Learning Automation	Correlation Coefficient	.586**
		Sig. (2-tailed)	.000
		N	271

Source: SPSS V. 26 Output (2024)

The first hypothesis (H01) posited that Machine Learning Automation has no significant influence on the firm effectiveness of manufacturing companies in Nigeria. The Spearman's rho correlation analysis was used to test this hypothesis, with the correlation coefficient indicating the strength and direction of the relationship between machine learning automation and firm effectiveness.

The correlation coefficient (0.586) indicates a moderate positive relationship between machine learning automation and firm effectiveness. This means that as machine learning automation is increasingly implemented, firm effectiveness also tends to increase in a meaningful way. The p-value (0.000) is less than the standard significance level of 0.05, which implies that the result is statistically significant.

Therefore, the null hypothesis (H01) is rejected. This suggests that machine learning automation has a significant positive influence on the firm effectiveness of manufacturing companies in Nigeria.

4.2.2 Test of Hypothesis II

H02) Robotic Process Automation has no significant influence on firm effectiveness of manufacturing companies in Nigeria.

Table 4.3 Test of Hypothesis II

			Firm Effectiveness
Spearman's rho	Robotic Process Automation	Correlation Coefficient	.504**
		Sig. (2-tailed)	.000
		N	271

Source: SPSS V. 26 Output (2024)

The second hypothesis (H02) suggested that Robotic Process Automation (RPA) has no significant influence on firm effectiveness in Nigerian manufacturing companies. The Spearman's rho correlation was again used to assess this relationship.

The correlation coefficient (0.504) indicates a moderate positive relationship between robotic process automation and firm effectiveness. This suggests that an increase in the use of RPA is associated with an improvement in firm effectiveness. The p-value (0.000), being less than 0.05, signifies that the relationship is statistically significant.

As a result, the null hypothesis (H02) is also rejected. This finding implies that robotic process automation has a significant positive influence on firm effectiveness among manufacturing companies in Nigeria.

4.3 Discussion of Findings

The finding that machine learning automation significantly influences firm effectiveness among manufacturing companies in Nigeria is supported by empirical evidence from several studies. Wang, Huang, Xia, and Shi (2024) demonstrated that AI enhances firms' innovation efficiency, indicating that machine learning, as a subset of AI, can substantially improve operational efficiency and effectiveness. Their research highlights how AI's ability to process and analyze large datasets can lead to better decision-making and improved performance outcomes. Similarly, Ifekanandu, Ezirim, and Kingsley (2023) found that AI technologies significantly boost marketing performance, including sales growth and market share, reflecting how machine learning's capabilities extend beyond innovation to operational success. These findings are consistent with Badghish and Soomro (2024), who identified AI's critical role in enhancing SMEs' operational and economic performance by improving efficiency and effectiveness. Conversely, Idu, Onodi, and Nwosu (2022) observed that while AI improved environmental reporting, it had a limited impact on economic reporting, suggesting that the benefits of machine learning may vary across different business aspects. Overall, these studies collectively support the significant role of machine learning automation in enhancing firm effectiveness, validating the positive correlation found in the Nigerian manufacturing sector.

The finding that robotic process automation (RPA) significantly impacts firm effectiveness is consistent with broader research on automation technologies. Badghish and Soomro (2024) highlighted how AI, including RPA, improves operational and economic performance, underscoring the value of automating repetitive tasks to boost firm effectiveness. Similarly, Hashem and Alqatamin (2021) found that AI, which encompasses RPA, enhances the efficiency of accounting information systems (AIS) by improving reliability and understandability, which directly contributes to non-financial performance improvements. This

aligns with the finding that RPA positively affects firm effectiveness by streamlining routine processes. Conversely, Chukwuemeka-Onuzulike (2023) observed that AI's impact on SME growth in Anambra State significantly affects business model design but did not specifically focus on RPA. This indicates that while RPA's benefits are substantial, the extent and nature of its impact may vary depending on the specific context and application. The evidence from these studies collectively supports the assertion that RPA contributes positively to firm effectiveness, highlighting its role in enhancing operational efficiency and performance in the manufacturing sector**.**

5.0 Conclusion and Recommendations

Artificial Intelligence in accounting is becoming increasingly critical for firms in the manufacturing sector, particularly in a competitive and dynamic environment like Nigeria's. AI offers numerous benefits, including improved accuracy in financial reporting, better decision-making, and enhanced operational efficiency, all of which contribute to overall firm effectiveness. As more companies recognize the value of AI, its role in accounting is expected to expand, further transforming how businesses manage their financial operations. The analysis of the relationship between Machine Learning Automation and firm effectiveness among manufacturing companies in Nigeria reveals a significant positive association. This finding indicates that as the adoption of machine learning automation increases within firms, their overall effectiveness tends to improve. The positive correlation observed can be attributed to these benefits. Firms that implement machine learning automation likely experience more efficient operations and better decision-making capabilities, leading to increased firm effectiveness. Also, the correlation between Robotic Process Automation (RPA) and firm effectiveness in Nigerian manufacturing companies is also notably positive. This result indicates that greater use of RPA is associated with enhanced firm effectiveness. By reducing the manual workload and minimizing errors, RPA allows employees to focus on more strategic activities. This efficiency boost contributes to improved overall firm effectiveness.

The implications of these findings are substantial for manufacturing companies in Nigeria. Both machine learning automation and robotic process automation have been shown to significantly enhance firm effectiveness. Machine learning automation improves decision-making and operational efficiency by providing advanced data analysis capabilities, while robotic process automation streamlines routine tasks, reducing errors and freeing up resources for more strategic activities. These technologies collectively contribute to greater overall effectiveness by optimizing processes and improving accuracy. For firms looking to boost their performance and competitiveness, integrating these advanced automation technologies offers a promising avenue for achieving operational excellence and sustained growth. The significance of these results highlights the importance of investing in and adopting such technologies to gain a competitive edge in the manufacturing sector. The study therefore recommends that:

1) Chief Financial Officers (CFOs) are specifically encouraged to explore and implement machine learning solutions to enhance data analysis capabilities, improve financial forecasting, and increase overall operational efficiency.

2) Operations Managers and Accounting Department Heads are advised to deploy Robotic Process Automation tools to automate repetitive tasks such as data entry and transaction

processing. This will reduce manual errors, increase efficiency, and allow employees to focus on more strategic activities, thereby enhancing firm effectiveness.

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