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THE IMPACT OF AI INFRASTRUCTURES ON SMALL AND MEDIUM ENTERPRISES (SMES) PERFORMANCE IN EDO STATE NIGERIA

Iyamah Edward .E and Oguh Festus A. Ph.D.
Department of Business Administration, Wellspring University Benin City Nigeria
Email: *sabicconsult7b@gmail.com; Festusoguh1970@gmail.com*
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Abstract: Artificial Intelligence (AI) is rapidly transforming industries globally. However, its adoption by Small and Medium Enterprises (SMEs) in developing countries like Nigeria remains limited. This study aims to investigate the impact of AI infrastructures on the performance of SMEs in Edo State, Nigeria. The research explores the relationship between AI infrastructure components, including data, computational power, and skilled workforce, and key performance indicators of SMEs. Through a mixed-methods approach, the study analyzes the challenges and opportunities associated with AI adoption, such as data quality, computational resources, and lack of technical expertise. The findings suggest that AI infrastructure can significantly enhance SME performance by improving decision-making, optimizing operations, and enabling innovation. However, several barriers hinder AI adoption, including high costs, lack of awareness, and regulatory challenges. To address these issues, the study proposes strategies such as government support, capacity-building programs, and collaborative partnerships. By understanding the impact of AI infrastructures on SMEs, policymakers, businesses, and researchers can work together to accelerate AI adoption and unlock its potential for economic growth and social development in Nigeria.

Keywords: AI Infrastructure; SME Performance; Digital Transformation; Data Variables; Computational Variables

Introduction

The Nigerian government, traditionally, receives more attention when it comes to the provision of services for the public. However, over the past years, academia has increasingly chosen to investigate services that are not only provided directly by the public sector but also play a growing role in the private sector. One such service is the nationwide introduction of a substantial infrastructure for Artificial Intelligence (AI). AI is becoming one of the most talked-about technologies. However, the development, production, and use of AI technologies are still in a stage of infancy in most countries in general and in Nigeria in particular. Many countries are currently making substantial investments in an attempt to catch up with the global leaders in AI. These investments pertain to all aspects of the AI value chain: development, both products and services, testing, implementation of AI infrastructures, and use of AI technologies (Manyika, Chui, Miremadi, Bughin. George, Willmott, and Dewhurst, 2017)..

First, their direct interests and contributions offer an explanation and characterize the resources and policies they need to capitalize on the benefits of AI. The paper reviews AI infrastructures such as data, skills, computing, and federal support systems as researched and suggested by AI National Strategy for Nigeria by the AESG, Nigeria (Knight, 2019).. There is limited research specific to developing economies concerning the discourse of AI infrastructure and its impact on SMEs' performance. Consequently, the study shows that the argument is hard to work on, due to the lack of public data containing specific insights related to AI performance in emerging-market environments. This is particularly important for SMEs in Nigeria, where the advantages and costs of each AI infrastructure can vary greatly from those observed from the present practice on data-intensive established economies. The study has notably important implications for actually preparing the Nigerian system for the contribution and success by the missing middle.

Today, emerging technologies direct SMEs in fostering their performances and capabilities. ICT such as e-commerce, enterprise systems, and RFID have gained the attention of SMEs and are known as deciding factors in SMEs' effectiveness and survival. SMEs contribute to economic growth through job creation and improving the economic efficiency of both developed and developing countries. Enhancing SMEs' performances and enabling them to compete strongly in global marketplaces are critical factors.

Problem Statement

The sudden evolution of artificial intelligent technologies (AI) has led to rapid integration and development of industries as it produces the next wave of digital-discovery technologies that are as significant as the appearance of steam power and IT devices (Jadhav, 2021). It has and will continue to represent breakthrough inventions in areas with significant economic value. Despite this promise, businesses in Nigeria and Africa have had the slowest AI adoption rates around the world. Most AI innovations fail as a result of insufficient infrastructure (Khurram, Hussain & Hassan, 2021). Enabling AI infrastructures enhances Nigeria and Africa's capacity for optimal technology advancement. In this paper, the current field of thought on AI technology in developing economies and practical arguments presented by small and medium enterprises (SMEs) in their attempt to jump onto the AI race are conceptualized. SMEs are a significant economic agent across Nigeria, hence they hold an important position in policy strategies about competitiveness. As SMEs are a vital part of the business sector activity worldwide, there are several problems with the ICT assimilation by SMEs linked with the e-readiness index, the perception of the management, and the use of infrequent assessment tools. Furthermore, AI could offer SMEs the benefit of taking advantage of a set of scalable capabilities. This may support the efficiency of Nigerian SMEs. The concept, however, has not been thoroughly examined, particularly in finding out the variables that are essential for its achievement.

Research Aim and Objectives

The overall aim of the study is to examine the impact of AI infrastructure architecture for SMEs in Nigeria that will support their performance. The specific objectives are to:

1) To examine the effects of data variables on the performance of SMEs in Edo State Nigeria.
2) To evaluate the impact of computational variables on the performance of SMEs in Edo State Nigeria.

Hypothesis

H1: Data variables have no significant impact on the performance of SMEs, particularly in Edo State.

H2: Computational variables does not have significant impact on the performance of SMEs in Edo State Nigeria.

Scope and Significance

The adoption of artificial infrastructure in the Nigerian oil and gas sector can lead to efficiency improvements. Consequently, understanding the factors that influence the government and firms' actions in this area could be crucial. This study is significant in many ways. First, empirical studies that examine the implementation of infrastructure in the Nigerian context are very scarce. The relationship between AI infrastructures and performance in emerging economies, particularly in Africa, hardly gets any mention in the existing literature. This study also compares small and medium-sized enterprises to large firms, particularly foreign subsidiaries, which the World Bank report refers to as "proof of performance." The structure of the report is as follows: Section 2 examines the related literature, and section 3 provides background information and hypotheses development. Section 4 deals with the research methodology, while section 5 focuses on the findings, and section 6 concludes. The scope of this study is primarily small and medium enterprises (SMEs) in all sectors of the Nigerian economy compared with subsidiaries of multinational firms in the country. Small and medium firms have been caught in the web of globalization and international business, and their activities in no small measure contribute to national development and growth. However, for many reasons which include financial constraints, small and medium-sized firms in emerging economies are different from their counterparts in developed countries. While small and medium-sized firms in developed countries may be equipped with trained and experienced staff, firms in emerging economies may not possess the required technical expertise. Consequently, infrastructure issues become paramount.

Literature Review

Understanding the concept of AI Infrastructures

The demand for AI innovations has boomed in the finance, auto, health, and education sectors and is driving SMEs towards AI infrastructures. AI infrastructures like machine learning, deep learning, and natural language processing enable an organization to benefit importantly from machine learning with less complexity and time-to-market. They also help in an organization's ability to solve complex data business problems at scale. AI infrastructure is one of the emerging trends that are able to run resident HPC applications and workloads, leadership-class artificial intelligence, big data, data, and analytics workloads. In recent times, graphics processing unit (GPU) and GPU-accelerated computing are driving breakthroughs in artificial intelligence, deep learning, and other techno-scientific, business, and computing environments. AI infrastructure projects assist in yielding the knowledge and capabilities required for SMEs to drive new AI and data science projects in their sectors. These types of projects make the full data potential from AI-driven infrastructures significantly accessible to the scientific community, engineering schools, economic sectors, middle-class citizens, and society at large. Our missions facilitate the adoption of AI and data science technologies by providing SMEs with in-depth knowledge on the expertise and use cases for using artificial intelligence in conjunction with data, analytics, web technologies, and technologies used for facilitating web-based algorithms.

Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. In computer engineering, AI deals with the design of machines that can perceive their environment, learn from it, solve problems, think, and act. AI research has progressed tremendously and is evolving rapidly. It is now a vital part of the technology industry and impacts countless domains. The cognitive functions of AI, such as problem-solving, learning, speech recognition, and planning, make it a very efficient tool and a vital part of our daily lives.

Components of AI Infrastructures

According to Ceccagnoli et al., AI has the capacity to transform industry activities and foster innovation. Examples of the AI tools used to address business problems span from the use of analytical tools to neural network algorithms, and all forms of machine learning. AI is also being used to provide virtual assistance, quality insurance diagnostics services, and natural language assessment services. However, using AI tools to build a world-class product often requires significant resources. For very large firms worldwide, investment in AI tool capabilities has multiplied considerably. Small and medium enterprises appear to have been left behind in this. According to the results of a 2020 firm survey by OECD, only around 17% of small and medium enterprises in industrializing countries had adopted cloud computing, which is a lead indicator of AI technologies, and 35% of small and medium enterprises. Most firms in the OECD see a supportive government strategy as essential for the small and medium enterprises to reap the AI and data-related opportunities rather than see them as added threats. Few AI studies have been undertaken to impact on SMEs in manufacturing sectors with manufacturing firms being members of the European Union.

The field of artificial intelligence (AI) involves the development, creation, and use of computer science and computer control systems to perform intelligent tasks. The application of AI in organizations comprises intelligent software applications, including knowledge-based information systems, and the implementation of expert systems. To position Nigeria as a net exporter of software, the government implemented various schemes to promote indigenous software development. World Bank and UNESCO data show that government policies have succeeded in increasing the number of software engineers in the country. To address the challenges facing SMEs in Nigeria, this study promotes entrepreneurship in software application development and implementation. The study examines the impact of AI in business on small and medium enterprises in Nigeria.

Variables to measure AI infrastructure architecture for SMEs in Nigeria that will support their performance

Data Variables

Large enterprises possess and use massive rich data for building their AI-powered products, services, and optimization of existing business processes and models. Modern AI approaches, especially deep learning, are data-hungry and large volumes of high-quality (labeled) training data are required to develop efficient and high-performance AI models, which demand significant investment. SMEs in Nigeria usually have small datasets (size and wealth) and a poor likelihood of obtaining quality training data needed to compete with bigger corporates in AI investment.

*Data volume**:** The amount of data that the SME has access to for training and using AI models. This can include data from internal sources (e.g., customer transactions, sales data) and external sources (e.g., social media data, public datasets).*

*Data quality**:** The accuracy, completeness, and consistency of the data. Poor data quality can lead to inaccurate AI models and poor performance.*

*Data accessibility**:** How easily and quickly the data can be accessed by AI models. This includes factors such as data storage location, data format, and access permissions.*

Computational variables

Enterprises need experienced researchers and developers with hands-on experience and knowledge of machine learning tools, APIs, libraries and frameworks, like TensorFlow, PyTorch, Scikit-learn, Caffe, among others.

These open-source AI tools are important for rapid prototyping, building, training, deploying and managing AI models at scale, to solve problems faced by both small and large enterprises in Nigeria. This access to unprecedented opportunities for SMEs in Nigeria to distinguish themselves from their competitors and gain significant positions in their industries. SMEs will lack the full range of benefits that businesses operating in Nigeria will enjoy if they start to explore AI infrastructures now. However, because of some peculiar challenges and bottlenecks associated with investing in AI, the timing of this may be important to them.

Processing power**:** The amount of computing power available for training and using AI models. This can be measured in terms of CPU cores, GPUs, or TPUs.

Storage capacity: The amount of storage space available for data and AI models.

Network bandwidth: The speed and capacity of the network connection for accessing and transferring data.

Concept of Small and Medium Enterprises in Nigeria

There is an internationally incessant call for financial institutions to pay considerable attention to their obligation without neglecting all forms of financing to MSMEs for several reasons. These include their increasing task as the engine of growth for stimulating entrepreneurial activities and as a vehicle for promoting sustainable job creation, as well as a catalyst for development, reducing poverty, and promoting equity and social developmental stimulation. They represent the domain of competitiveness of large-scale countries in the market. They develop the industrial and service sectors and help promote economic development. They are capable of making considerable innovations due to their receptivity, speed, and flexibility in meeting customers' new demands. They are the benchmark of local market strength and robustness, and they contribute to the reinforcement of a country's financial stability. Due to their great job-creating and economic development capacity, they warrant special attention from policymakers and regulatory authorities.

According to the United Nations Industrial Development Organization, SMEs are business enterprises that contribute to the growth of the economy and society. They address some of the most pressing gap issues, such as unemployment, and bring goods and services to meet the basic needs of the nation's major population share, thus contributing to poverty alleviation. A small or medium-sized enterprise (SME) is often defined according to the number of employees or recordable incorporations required by the government annually. A firm's size can significantly influence its competitive strength in the market; however, special conditions for their development have to be put in place due to their dynamic state in the global market.

Overview and Characteristics of SMEs

SMEs' performance was reviewed as an enormous contribution to business development in advanced economies, with a particularly extraordinary influence on economic development. Furthermore, the performance of SMEs is being increasingly studied by academics to guarantee company sustainability. Despite the achievements and profits of small and medium-sized enterprises, their objectives become more entrenched, thus driving the growth and penetration of small and medium-sized enterprises in various niches. However, while advances enable this process, industrial and operational efficiency is not obtainable famously due to the expense, particularly of new or non-flexible products and the market capture choke point. More generally, we notice that current limits in the performance of AIML models massively increase the financial resources necessary to complete associated problems. Finally, SMEs' companies, particularly those in Nigeria, should have a solid understanding of the benefit of the current advances in AIML and associated infrastructures to think about AI and AI investments.

The application of AI infrastructures in business contexts requires certain profound investigations. In the business arena, AI applications are known for their potential to disrupt the status quo and transform industries in the next decade. In current business practice, Small and Medium Enterprises (SMEs) operating in Nigeria are involved in growing wares, offering resources and trading services to the less privileged. Through its diversity, the SME sector has given substantial contributions to sustainable development, job creation, and poverty eradication in emerging markets. Languages, computers, and technology adoption in Nigerian businesses were reviewed in detail, and they concluded that businesses in Nigeria experience some challenges in doing business online. These challenges include the negative attitudes of business owners, lack of skill, technical knowledge and financial constraints, lack of exposure, and lack of business confidence as well as concerns about technology-related political and regulatory consequences.

Challenges and Opportunities

The AI and infrastructure solution set keeps growing and evolving over time. The digital divide is a real and increasing phenomenon, especially at the global level. Nigeria has its own digital divide as well as across its own domestic economy, where many micro and small business managers in the Nigerian SME sector see no potential benefits or opportunities for using advanced digital technologies such as AI in their business. Hence, adopting the opportunities for growth and sustainable development that is being offered by AI involves much decision making not only on the part of Nigerian micro, small, and medium business managers but by their stakeholders too. The use of AI infrastructure is essential and indispensable not only for decision makers in the Nigerian SME sector but also for stakeholders. Stakeholders have more complex roles with multiple objectives around aspects such as sustainability and impact on nature as stakeholders are also consumers and they often advocate smart technologies.

Third, the use of Open Educational Resources (OER), which are openly available educational materials that any individual can reuse to learn more about the use of AI in business, should be encouraged so that businesses can have the basic know-how to get started. This is important to SMEs, offering solutions to many challenges and engaging them to learn about them. Small companies require multiple forms of knowledge on how to access the potential benefits of new technology.

Second, the use of big data that will support many important economic processes in the Nigerian economy should be encouraged. This will give Nigerian startup firms access to key data and a level playing field with incumbent companies.

In order to get SMEs to adopt new technologies, several educational technologies must be put in place. First, training, awareness, and capacity building sessions need to be organized regularly for SMEs on the importance and benefit of adopting AI in their business operations. Potential AI users such as the organizational management need to develop their existing experiences and increase their trust in using AI applications to make decisions. They need to be trained in the new technology to improve their confidence in using unfamiliar technologies.

AI Adoption in SMEs

Artificial Intelligence, including big data and machine learning, has the potential to enhance organizational performance by providing information that was not previously known. Although large enterprises have embraced AI rapidly, small and medium-sized enterprises are lagging. The study offers insights on the base of AI adoption in SMEs in Nigeria by developing an extended innovation diffusion model that includes AI infrastructure in conjunction with the Unified Theory of Acceptance and Use of Technology (UTAUT) model. For this study, data

were collected from 305 senior-level managers working in SMEs in Nigeria, using stratified sampling. The article shows that the UTAUT are good instruments and AI adoption is influenced by UTAUT, AI attributes, individual factors, social factors, innovation attributes, and organizational readiness. The findings of the study have theoretical and managerial implications. No studies have reported this approach before, indicating that the study has significant value.

Small and medium enterprises are not independent entities as they offer both artificial intelligence (AI) infused products and services. The priority SMEs accord to AI adoption can determine their relevance in the market. This study investigates the drivers of AI adoption in small and medium enterprises in Nigeria. The result shows that management support, belief in reflection-enhancement principles, supply chain integration, top managerial influence, and perceived firm performance significantly determine AI adoption in SMEs. These findings emphasize the role of top management in AI adoption in SMEs such that when top management supports and influences AI usage, the performance of SMEs will improve. The study concludes by advocating inclusivity and immediate action by SMEs and the government.

. **Global Trends and Statistics**

Companies can position themselves much more strongly in the long term as technological leaders and in global marketing with AI, as well as pursue new business models. They therefore invest significant resources in a wide variety of AI technologies such as machine learning, industrial robotics, and machine learning methods in human-machine interaction, etc. There are also simpler intelligent AI systems that demonstrate and explain human-like abilities, making them comprehensible and transparent. However, practical migration scenarios and pragmatic ways to assess potential application areas, as well as the added value of such AI applications, are very rare. The available information on AI platforms is mainly concentrated on mere research trends. The available confirmations do not say much about AI platforms' effectiveness and the actual readiness for actual use in such applications.

Developments in artificial intelligence (AI) and cloud computing infrastructures are provoking a high level of interest within the business community in Nigeria. Although research studies have been conducted on the Internet of Things and big data platforms, the examination of global trends, statistics, and regional analysis of these knowledge assets and their impact on small and medium-sized enterprises (SMEs) in the literature are very limited. This paper addresses this important theoretical and practical gap by providing the global trends of the Internet of Things and big data platforms, the market value, and analysis of the global relevance of these technology terms. Through these insights, efforts could be directed towards understanding the influences and mechanisms by which the value of IoT and big data platforms as important knowledge assets can be harnessed to enhance SMEs' performance and advance business prosperity in Nigeria within the context of AI infrastructures.

Barriers to Adoption in SMEs

Implications: Runtime analysis of company performance with AI infrastructures is very reflective of the AI readiness and AI ecosystem that the technology provider and other stakeholders have articulated and promoted. SMEs, particularly in traditional commerce, have not benefited much from employing AI tools yet, while those that are benefiting have limited their adoption and deployment to limited interest. The few that have implemented AI deploy it in very limited areas and sectors. The fact that in the recent economic potentials of deploying AI in Nigeria, only certain sectors are benefiting, while others have either not bothered to or lacked the prerequisites to actualize the affiliated advantages posed by deploying generate groups of attitudes. It has created a sustained

focus on a few sectors, thereby narrowing the scope of achievable challenges higher if the economic and business potentials can deliver lasting changes, taking into account the actualization of the overall pledge and centering on human safety, security, and health interest and the way people engage with AI. There are also a group of businesses that perceive AI as a temporary cost center asset and have very limited requirements or long-term investment needs.

Barriers that influence the predisposition in small and medium enterprises in adopting an innovation can restrain the likelihood of adopting AI technologies. Prominent among these is the cost implications of acquiring the technologies, gaining acquired skills and competencies needed in the value chain process. The study revealed SMEs generally have poor information culture, retail customer database, and related knowledge of the significant attributes of their customers that AI can ameliorate. The nature of the business, the technologies, and the tools also vary with their patterns of usage. The pattern in urban regions is temporal in nature that can pose an additional challenge of not being sufficient or large enough to warrant the investments while others can be disadvantaged if they are unable to embrace innovation as it emerged. SMEs in Lagos and other major cities will find it difficult to keep up with these socio-economic trends if this anomaly is not addressed by looking into the rural-urban divide.

Benefits of AI Infrastructures for SMEs

Mass customization and personalization of products. The unification of 3D printing in the production line accelerates product personalization, mass customization, and supply chain effectiveness. This would stimulate and motivate the manufacturers and customers. The integration of 3D modeling improves the quality of production and the supply chain, reduces the cost of transportation and stock formulation, and increases the platform for product life expectancy. Enhancing product personalization with MDP demonstrated a reliable and dependable organization dealing with indoor and outdoor products without any preselection above other methods and tools. To increase the quality and authenticity of the produced cupcake models and images, conditional GANs models aid the definition of the best design shape for cupcake topping.

Product quality enhancement. Fashion industry products can be enhanced through the effective generation of fashion forecasts with the aid of commercial deep learning programs and algorithms to relate the industry products and meet customer fashion expectations. Optimized product performance can be achieved with the use of optimized GAN with genetic algorithm for optimization of the process for product development. The effective transitional marriage of radio-frequency identifier technology system and product development would enable small and medium-scale companies to facilitate the identification of products through the integration of profitability and technological processes to meet the requirements of companies and customers. Small ready-to-wear garment companies can use pattern designing software with editing AI and easily define the relationship of the product to the structure and wearability of the product by learning AI algorithms. The structure and simplicity of use for the personalization of the pictures and the visualization of product quality for look books, and the patterns would transform and boost the development and deployment of an AI system for product planning. The fulfillment of product expectation and structure can be achieved through the programming of deep feedforward networks capable of handling fabric image composition and content.

5.1 Cost effectiveness in product development and prototyping. It enhances the development of genuine products and market prototyping in comparison with traditional prototyping tools through a blend of deep learning to improve and enhance the aesthetic qualities of the products, making the product pleasing at the same time. SMEs

can mine maximum benefits from the QFD dataset with the aid of deep convolutional auto-encoder by illuminating and highlighting significant customer requirements and needs for defining prototype models for efficient and effective application. Bootstrap samples can be used to yield relative results of the statistical procedures for the recurrent genetic algorithms with covariance matrix adaptation in the optimization of mould-cavity path for product prototyping at minimal cost and time.

The benefits of utilizing AI infrastructure by SMEs in manufacturing processes are enormous and life-saving in executing and deploying such novel tools on a small scale. Some of these benefits include:

Operational Efficiency and Cost Reduction

The use of AI-based tools for functional improvements, such as cost reduction and operational efficiency, can help improve organizational performance. The adoption of the AI infrastructure can provide potential improvements to the way existing business operations are performed. The use of AI-based systems can generate significant solutions to the increasing operational and maintenance costs encountered by the various small and medium enterprises in Nigeria. This will reduce operational expenses and increase the organization's impact. SMEs will be able to understand and manage the installed equipment better than before. This is possible through an intelligent embedded sensor and a potential reduction of maintenance cost of opportunity levels. Inadequate AI infrastructure implementation can lead to limitation, poor performance, and downtime of production, inefficient business operations, suboptimal performances, and increased operations and maintenance costs due to unexpected critical failures in the facility. SMEs need to have evidence of the financial benefits of investing in AI infrastructures, through reductions in the cost of operations made possible by eliminating production inefficiencies, excessive downtime, and an increase in product quality.

Operational efficiency has to do with the quality and timeliness of operations, processes employed in transformation and procurement of goods, and can also include operating costs, utilization of resources, and flexibility available to a firm. Companies are faced with increasing pressure to reduce costs and improve operational efficiency. There is a significant effect of the AI infrastructure on reducing operational costs. This has an implication that an organization that lags may encounter an increase in their operational costs, which may affect the business success and employee's satisfaction. SMEs that utilize AI-based systems to achieve operational efficiencies perform better than those that do not.

Enhanced Decision-Making

Similarly, many CEOs in Lagos, Nigeria stated that both the use of AI and automated customer interfaces are performing well in the retail sector. The use of AI is helping customers to execute, improve and manage services, make informed choices about resources entails customers' actions, processing payments, and monitoring service delivery in real-time. This further suggests that guided customers through the interface and then apply automated rules to recognize patterns to assist enable data analytics on sales volume and customer purchase preferences, as well as lessening the number of hours of customer socializing, human interaction for customer support and relations management. This strategy laid an increased time for these small business firms to effectively participate in complex and higher-value interactions. It can further be stated that AI tools are fast, responsive, and detail-oriented. They can perform any number of customer interactions simultaneously, taking in reactions with reduced transactional errors and immediate data entry in customer records.

Small and medium enterprises (SMEs) benefit enormously from AI infrastructures as this will allow them to make better-informed decisions and improve productivity. This plan aligns with how Sirisena and Mmatlou elaborate

on SMEs in Stellenbosch, South Africa by stating that most SMEs in Stellenbosch are using AI to leverage customer data from various sources, to expand on existing telecommunications platforms in designing other digital channels, and to increase customer engagement. This study affirmed that empowering a business firm with AI tools can contribute to improved decision-making processes, insight generation from customer data, pattern recognition, trend analyses, and proactive customer service.

Theoretical Framework

. Resource-Based Theory (RBT)

The theory was first put forward by Penrose (2009), who proposed a model on the effective management of firms' resources, diversification strategy, and productive opportunities. Penrose's publication was the first to propose conceptualising a firm as a coordinated bundle of resources to address and tackle how it can achieve its goals and strategic behaviour (Penrose, 2009;Penrose, 2009). RBT began to take shape in the 1980s.The antecedent of RBT was the Theory of the Growth of the Firm. Later, during the 1990s, Jay Barney's work was critical to the emergence of RBT and became the dominant paradigm in strategic management and strategic planning.

RBT provides a framework to highlight and predict the fundamentals of organisation performance and competitive advantage. The focus of RBT on the firm's performance based on meso perspectives was a reaction to the earlier managerial interest in the industry structure, a more macro perspective. RBT addresses an internally-driven approach by focusing on internal organisation resources, as opposed to externally driven approaches to understanding the accomplishment or failure of leveraging organisational activities (Kozlenkova, Samaha & Palmatier, 2014). It aims to elaborate on imperfectly imitable firm resources that could potentially become the source of sustained competitive advantage (Barney, 1991).

Some confusion persists concerning the label for the theory, whether to appropriately use the term resource-based theory (RBT) or resource-based view (RBV). Some research papers refer to the theory as RBT based on the evidence that the view has evolved into a theory, but some others refer to RBV. However, reflecting on the research community's perspective, several research assessments support the RBT's credentials (Kozlenkova, Samaha & Palmatier, 2014; Crook et al., 2008).

This theory suggests that a firm's competitive advantage comes from its unique and valuable resources. In the context of AI infrastructure, this translates to:

Valuable resources: Powerful computing resources, access to large and relevant data sets, and skilled personnel to manage AI models.

Rarity: Not all SMEs will have access to these resources, making them a potential differentiator.

Inimitability: The complexity and cost of setting up a robust AI infrastructure can make it difficult for competitors to imitate.

Non-substitutable**:** There may not be a readily available alternative to achieve the same level of performance improvement offered by AI.

Empirical review

Bettoni et al. (2021) in An AI adoption model for SMEs: a conceptual framework . The AI Maturity and Adoption Model. Offer a model for SMEs to access and adopt AI. Qualitative: All the data is gathered through interviews. A total of 39 companies' interviews were conducted. Able to develop a conceptual framework that will help SMEs

adopt AI. Their research provides the reason why SMEs are still not adopting AI and what should be done to change it.

Denicolai et al. (2021) paper on Is there a way for SMEs to prepare for globalization, digitization, and sustainability? Analyzing the complementary and substitutive impacts of various developments. Readiness life cycle model. To see if AI readiness has any effect on SMEs performing internationally. How sustainability effects digitalization and Internationalizati on. Quantitative: A survey was conducted which involves a total for 438 SMEs. SMEs included are both national and international. They found that when any SMEs decided to go international, AI influence it positively in many ways. Secondly, sustainability and digitalization are positively related to each other but turn competitive against each other when SMEs goes international.

Sharma et al. (2022) paper on Why Do SMEs Adopt Artificial IntelligenceBased Chatbots? Technology Organizatio n Environmen t (TOE) Investigate all those factors that influence SMEs to adopt AI based chatbots. Quantitative: An online survey was conducted where data was collected from 292 SMEs. They were able to investigate what factors influence SMEs to adopt AI based chatbot. Results shows that factors like employees' capability, financial support,

Chaudhuri et al. (2022) article on Innovation in SMEs, AI Dynamism, and sustainabilit y: The current situation and way forward Expectation Disconfirmati on Theory (EDT), TechnologyTrust-Fit Theory (TTF), Contingency Theory Impact of AI dynamism on the sustainability of SMEs. Moderating effect of technological and leadership support for AI technologies for manufacturing and production firms. Quantitative: Data was collected from 343 managers of SMEs. They found out that four characteristics effect AI development in manufacturing and production firm. Organizational, technological, situational and individual centric characteristics. Both leadership and technological support has a positive effect on the implementation of AI which ensure firms sustainability

Rawashdeh et al. (2023) Determinants of artificial intelligence adoption in SMEs: The mediating role of accounting automation Technology Organization Environment (TOE) Examine what are those technological factors that influence the AI adaptation. Examine the role of accounting automation on AI in SMEs, Quantitative: Online surveys were used to gather the data from the owners and managers of different SMEs. A total of 40 owners and managers participated in the survey. Modern technologies that are linked with AI influenced the work in a very positive manner. Sometimes these link cause failures because of the underestimation that organization shows on many important elements. Study also shows that applying accounting automation on AI will help save a lot of time and effort.

Younus (2022) The Effect of Artificial Intelligence on Job Performance in China's Small and Medium Sized Enterprises (SMEs) Descriptive method and Data analyzation through SPSS How job performance can be affected by the use of AI in SMEs and what are the variables associated with it. Quantitative: A questionnaire was distributed among 220 managers of different SMEs.

. In order to fully understand the significance of AI for SMEs in Pakistan, Strusani & Houngbonon, 2019 paper discusses how AI may revolutionize human communication, access to resources, data collection, and product creation by vastly improving human intellect. The study found out that Artificial intelligence (AI) allows enterprises in developing countries to lower overhead and increase access to the market with innovative business models that can outperform traditional solutions and benefit the underserved. As technological solutions become increasingly important to economic success in many nations, it is possible that the goals of eliminating poverty and establishing shared prosperity will depend on harnessing AI's capabilities.

Research Gap

By looking at all the previous work that was done on AI and SMEs in Nigeria, we have found out that there is a huge gap available for research in this area. In the country like Nigeria , AI is still at a very developing stage and not much researches have been done on this field. We have also seen that the research available conducted on AI is strictly focused on one particular business. This gives us a huge opportunity to investigate how SMEs in Nigeria uses AI to grow their businesses. In order to fully understand the significance of AI for SMEs in Pakistan, we have studied a small number of publications. Despite the fact that even the most fundamental AI technologies are being used in emerging markets to tackle critical development issues, much more needs to be done, and solutions from the corporate sector will be crucial for scaling innovative business models, developing new ways of providing services, and increasing local markets' competitiveness. In order to maximize benefits and minimize risks, this cutting-edge technology calls for creative approaches to each of these problems

Methodology

In order for this study not to lose its pragmatic, problem-solving orientation, a great deal of time and other resources have to be devoted to developing a clear understanding of, and solutions to the real problems. Consequently, the research strategy for this project is a multi-method one designed to collect various forms of data from the perspective of the research objectives. The research design adopted is the survey research design whose data was cross sectional based on the variables under investigation.

The population of the study was drawn from the 2017 National Survey of MSMEs which covered enterprises in Nigeria employing below 200 persons (i.e. micro, small and medium enterprises - MSMEs), and was conducted in all the 36 States of the Federation and FCT. The total number of MSMEs as at December, 2017 stood at 41,543,028, with components as follows, viz: micro enterprises - MEs: 41, 469,947 (or 99.8 percent), small and medium enterprises - SMEs: 73,081 (or 0.2 percent). A sample size of 384 was determined using **The Cochran formula for analysis.** In order to reduce any bias that might result from surveying members of the private sector, government sector, or the telecommunication sector, improper weighting was used. Also, proportional allocations were used in selecting a given firm based on the total estimate in a sector in each LGA. The proportion of direct investment found in the different LGAs was used to develop a model for each LGA for each sector of the economy. On average, one randomly selected SME was used to represent the sector of each of the sixteen LGAs in the state.

Model Specification

The model put forward in this study is as follow:

$$y=f(x)$$

$$y = \beta 0 + \beta 1x1 + \beta 2x2 + \epsilon$$

Where

y= SMEs performance in terms of output generation

x= Artificial Intelligence(AI) infrastructures

x1= data variables in terms of data volume, data accessibility and data quality

x2= Computational variables in terms of Processing power, Storage capacity and Network bandwidth

4.1.1 Reliability Test Result

Table 4.1: Reliability Result for the Impact of AI Infrastructures on Small and Medium Enterprises (SMEs) Performance in Edo State Nigeria

Cronbach's Alpha	No of Items
.973	11

Cronbach's Alpha is a measure of internal consistency, indicating how well the items in a set are positively correlated to one another, and it is widely used to assess the reliability of a scale. The reliability result of Cronbach's Alpha 0.973 for the 11-item scale measuring the the Impact of AI Infrastructures on Small and Medium Enterprises (SMEs) Performance in Edo State Nigeria indicates a very high level of internal consistency. This suggests that the scale is highly reliable and that the items are well-aligned in measuring the intended constructs. Researchers can be confident in the scale's ability to consistently measure the the Impact of AI Infrastructures on Small and Medium Enterprises (SMEs) Performance.

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Preamble

This chapter presents, analyzes, and interprets the data collected from the sampled owner-managers of SMEs located across Edo State, Nigeria, on the Impact of AI Infrastructures on Small and Medium Enterprises (SMEs) Performance in Edo State Nigeria. A total of 348 copies of questionnaires were administered to the respondents, and 248 were returned, signifying an 71.2% retrieval rate. All the returned copies were properly filled out and used for the analysis of the study. Descriptive and inferential statistics were used to present and analyze the collected data, respectively. The descriptive summary of the demographic characteristics was presented using cross-tables, frequency counts, percentages, charts, means, and standard deviations. The stated hypotheses were analyzed with regression analysis using the Statistical Package for Social Scientists (SPSS v 20).

Table 4.1: Demographic information of the respondents

Variables and categorises		Frequency	Percentage
Gender	Male	76	61.3%
	Female	44	35.5%
	Prefer not to say	4	3.2%
Age	18-25	13	10.5%
	26-35	72	58.1%
	36-45	31	25.0%
	46-55	8	6.5%
Position	Owner	90	72.6%
	Manager / Supervisor	34	27.4%
Years of experience in current sector	Less than 2 years	18	14.5%
	2-5 years	45	36.3%
	6-10 years	44	35.5%
	11-15 years	13	10.5%
	more than 15 years	4	3.2%

Source: Field Survey (2024)

Table 4.1 presents the demographic composition and professional profiles of the surveyed individuals, offering a comprehensive understanding of the sample characteristics. This table presents demographic and professional characteristics of individuals surveyed, along with their frequencies and percentages:

The majority of respondents are male, comprising 61.3% of the sample; Female respondents account for 35.5% of the sample. A small percentage, 3.2%, preferred not to disclose their gender.

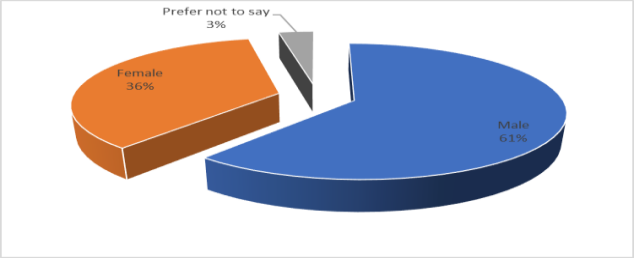


Figure 4.1: Gender of the respondents

The largest age group falls within the range of 26-35 years, representing 58.1% of the respondents. Those aged 36-45 make up 25.0% of the sample. The age groups of 18-25 and 46-55 account for 10.5% and 6.5% respectively.

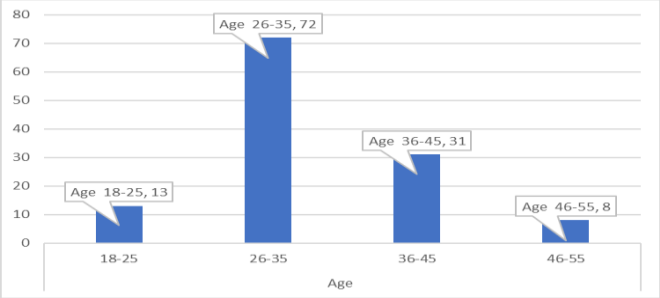
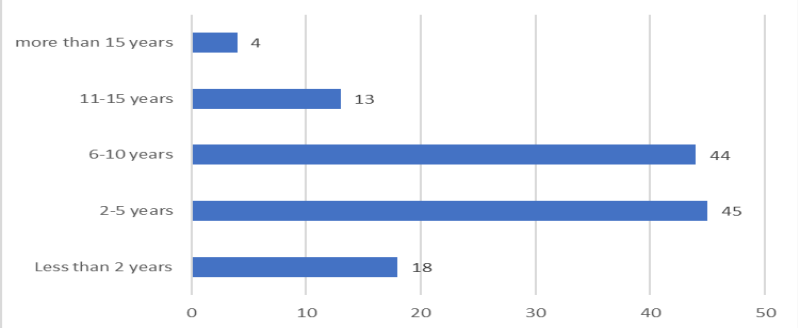


Figure 4.2: Age of the respondents

SMes owners constitute the largest cadre, comprising 72.6% of respondents. While the managers / supervisors constitute 27.4% respectively.

Figure 4.3: Position of the respondents

Respondents with 2-5 years of experience in their current sector represent the largest group, at 36.3%. Those with 6-10 years of experience follow closely, comprising 35.5% of the sample. The percentage decreases for respondents with less than 2 years and more than 15 years of experience.



4.2 Analysis of respondents' responses

Table 4.2: Data Variables

Items	SA (%)	A (%)	N (%)	D (%)	SD (%)	N	Mean	Std. Deviation
The volume of data I have access to for AI models significantly impacts the accuracy of the results my SME generates (e.g., sales forecasts, customer insights).	30.6%	28.2%	10.5%	11.3%	19.4%	124	3.40	1.50
The ease with which my SME can access data for AI models directly affects the efficiency of our operations.	29.8%	29.8%	4.0%	24.2%	12.1%	124	3.41	1.44
The quality and accuracy of the data I use for AI models play a crucial role in the overall performance and reliability of the outputs generated for my SME.	33.9%	25.8%	7.3%	17.7%	15.3%	124	3.45	1.49
Grand mean							3.42	1.47

Source: Field Survey (2024)

For the item concerning the volume of data available for AI models and its impact on the accuracy of results (e.g., sales forecasts, customer insights), 58.8% of respondents either strongly agreed or agreed, while 30.7% either disagreed or strongly disagreed. This indicates a general belief that data volume significantly influences the accuracy of AI-generated results, reflected in the mean score of 3.40. The standard deviation of 1.50 suggests moderate to high variability in responses, indicating differing perspectives among respondents.

Regarding the ease of accessing data for AI models and its effect on operational efficiency, 59.6% of respondents expressed agreement, while 36.3% disagreed. The mean score of 3.41 indicates a general consensus that easier data access positively impacts efficiency. However, the standard deviation of 1.44 points to moderate variability in opinions.

For the item addressing the quality and accuracy of data used for AI models and their role in the performance and reliability of outputs, 59.7% of respondents agreed, whereas 33.0% disagreed. The mean score of 3.45 suggests a slight leaning towards agreement, highlighting the perceived importance of data quality and accuracy. The standard deviation of 1.49 indicates moderate to high variability in responses, revealing differing views on this issue.

The grand mean of 3.42, averaging across all items, suggests a general tendency towards agreement with the statements, reflecting an overall perception that data-related factors significantly impact AI and SME performance. The grand standard deviation of 1.47 indicates moderate variability in responses, suggesting some diversity in respondents' opinions.

These findings imply that a substantial proportion of respondents perceive positive impacts of AI-related data factors on SME performance. However, the moderate to high variability in opinions highlights the need for targeted interventions to address concerns. Improving data access, volume, and quality could be strategic areas for enhancing the efficacy of AI in SMEs, potentially leading to better performance and reliabilit

Table 4.3: Computational Variables

Items	SA (%)	A (%)	N (%)	D (%)	SD (%)	N	Mean	Std. Deviation
The processing power available for AI models in my SME significantly impacts the time it takes to generate outputs (e.g., reports, predictions).	35.5%	22.6%	5.6%	16.9%	19.4%	124	3.38	1.57
The storage capacity dedicated to AI models and data in my SME directly affects the number and complexity of AI models we can utilize.	33.1%	24.2%	11.3%	15.3%	16.1%	124	3.43	1.48
Grand mean							3.405	1.53
Items	Very Fast (%)	Fast (%)	Neutral (%)	Slow (%)	Very Slow (%)	N	Mean	Std. Deviation
The speed and reliability ofinternet connection for transferring data related to AI models	37.9%	19.4%	6.5%	22.6%	13.7%	124	3.45	1.52

Source: Field Survey (2024)

The analysis of respondents' responses on the "Computational Variables scale" provides valuable insights into the impact of computational infrastructure on the performance of small and medium enterprises (SMEs) in Edo State, Nigeria. Summing up the responses for "Strongly Agree (SA)" and "Agree (A)" together, as well as "Disagree (D)" and "Strongly Disagree (SD)" together, reveals significant trends.

For the item concerning the processing power available for AI models and its impact on the time to generate outputs (e.g., reports, predictions), 58.1% of respondents either strongly agreed or agreed, while 36.3% either disagreed or strongly disagreed. This indicates a general belief that processing power significantly influences the time required to generate AI outputs, reflected in the mean score of 3.38. The standard deviation of 1.57 suggests a high variability in responses, indicating diverse perspectives among respondents.

Regarding the storage capacity dedicated to AI models and data, and its effect on the number and complexity of AI models utilized, 57.3% of respondents expressed agreement, while 31.4% disagreed. The mean score of 3.43 indicates a general consensus that storage capacity positively impacts the ability to use more and complex AI models. However, the standard deviation of 1.48 points to moderate variability in opinions.

For the item addressing the speed and reliability of internet connection for transferring data related to AI models, 57.3% of respondents indicated that the internet connection is very fast or fast, whereas 36.3% found it slow or very slow. The mean score of 3.45 suggests a slight leaning towards satisfaction with internet speed and reliability, highlighting its perceived importance for AI-related data transfer. The standard deviation of 1.52 indicates moderate to high variability in responses, revealing differing views on this issue.

The grand mean of 3.41, averaging across all items, suggests a general tendency towards agreement with the statements, reflecting an overall perception that computational factors significantly impact AI and SME performance. The grand standard deviation of 1.53 indicates moderate to high variability in responses, suggesting some diversity in respondents' opinions.

These findings imply that a significant proportion of respondents perceive positive impacts of computational factors on SME performance. However, the moderate to high variability in opinions highlights the need for targeted interventions to address concerns. Improving processing power, storage capacity, and internet speed and reliability could be strategic areas for enhancing the efficacy of AI in SMEs, potentially leading to better performance and efficiency.

Table 4.4: SME Performance

Items	SA (%)	A (%)	N (%)	D (%)	SD (%)	N	Mean	Std. Deviation
The outputs generated by my AI models (e.g., reports, forecasts) are highly accurate and reliable, leading to improved decision-making within my SME.	29.8%	41.9%	8.9%	4.0%	15.3%	124	3.67	1.35
The use of AI has significantly increased the speed and efficiency with which my SME generates reports, insights, and predictions.	25.8%	45.2%	4.0%	16.9%	8.1%	124	3.64	1.26
The quality of the outputs generated by my AI models has directly contributed to increased customer satisfaction and improved customer service within my SME.	33.1%	37.1%	8.1%	12.9%	8.9%	124	3.73	1.29
The outputs generated by my AI models have helped my SME identify new business opportunities and optimize existing processes, leading to improved overall performance.	29.0%	41.1%	3.2%	9.7%	16.9%	124	3.56	1.43
Overall, the AI infrastructure in my SME has significantly improved the quality and usefulness of the outputs we generate, positively impacting our business performance.	38.7%	31.5%	3.2%	16.1%	10.5%	124	3.72	1.39
Grand mean							3.664	1.344

Source: Field Survey (2024)

The analysis of respondents' responses on the "SME Performance scale" highlights the perceived impact of AI infrastructures on the performance of small and medium enterprises (SMEs) in Edo State, Nigeria. Summing up the responses for "Strongly Agree (SA)" and "Agree (A)" together, as well as "Disagree (D)" and "Strongly Disagree (SD)" together, reveals significant trends.

For the item concerning the accuracy and reliability of AI-generated outputs (e.g., reports, forecasts) and their impact on decision-making within SMEs, 71.7% of respondents either strongly agreed or agreed, while 19.3% either disagreed or strongly disagreed. This indicates a strong belief that AI outputs are accurate and reliable, improving decision-making, reflected in the mean score of 3.67. The standard deviation of 1.35 suggests moderate variability in responses, indicating a generally consistent belief in the reliability of AI outputs.

Regarding the speed and efficiency with which AI helps generate reports, insights, and predictions, 71.0% of respondents expressed agreement, while 25.0% disagreed. The mean score of 3.64 indicates a strong consensus that AI enhances these processes. The standard deviation of 1.26 shows less variability in responses, indicating broad agreement on this impact.

For the item addressing the quality of AI-generated outputs and their contribution to increased customer satisfaction and improved customer service, 70.2% of respondents agreed, whereas 21.8% disagreed. The mean score of 3.73, the highest among the items, indicates a very strong belief that AI improves customer satisfaction and service. The standard deviation of 1.29 suggests moderate variability, with most respondents agreeing on the positive impact.

The item about AI-generated outputs helping SMEs identify new business opportunities and optimize existing processes received 70.1% agreement and 26.6% disagreement. The mean score of 3.56 reflects a strong perception that AI aids in identifying new opportunities and optimizing processes. The standard deviation of 1.43 indicates moderate variability in responses, suggesting some differences in opinion.

Overall, 70.2% of respondents agreed that AI infrastructure has significantly improved the quality and usefulness of outputs, positively impacting business performance, while 26.6% disagreed. The mean score of 3.72 shows a strong belief in the benefits of AI infrastructure. The standard deviation of 1.39 suggests moderate variability, with a general agreement on the positive impact.

The grand mean of 3.664 indicates a strong tendency towards agreement with the statements, reflecting a general perception that AI infrastructure significantly enhances SME performance. The grand standard deviation of 1.344 indicates moderate variability in responses, suggesting some diversity in respondents' opinions.

These findings imply that respondents generally perceive a positive impact of AI on SME performance, particularly in decision-making, speed and efficiency, customer satisfaction, and overall business performance. The relatively lower standard deviations across most items highlight a consistent belief in the benefits of AI. These findings suggest that leveraging AI can be a strategic advantage for SMEs, with targeted investments in AI infrastructure potentially leading to substantial improvements in various performance metrics.

Hypothesis testing

Hypothesis one

H0: Data variables have no significant impact on the performance of SMEs, particularly in Edo State. .

H1: Data variables have no significant impact on the performance of SMEs, particularly in Edo State. .

Independent variable = Data variables

Dependent variable = Performance of SMEs

Regression analysis was used to test this hypothesis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	α	β
1	.393	.155	.150	.38532	31.084	0.000	1.575	0.220

The specific regression equation for this model:

Performance of SMEs=1.575 + 0.220 Data Variables

The regression analysis indicates that data variables have a statistically significant impact on the performance of SMEs in Edo State, Nigeria. The positive R value suggests a moderate positive relationship, meaning that as data variables improve, so does SME performance. The R^2 value shows that data variables explain 15.5% of the variance in SME performance, which, while not overwhelming, is a notable contribution. The significance of the F statistic (p-value < 0.05) leads us to reject the null hypothesis, confirming that the relationship between data variables and SME performance is significant. The regression coefficients further demonstrate the positive impact of data variables on SME performance.

A unit change in data variables leads to a 0.220 unit increase in SME performance. This demonstrates the positive and significant impact that improving data variables can have on the overall performance of SMEs. Enhancing data quality, volume, and accessibility within AI infrastructures can substantially contribute to better decision-making, efficiency, and overall business success for SMEs in Edo State, Nigeria.

Overall, the findings suggest that enhancing data variables within AI infrastructures could be beneficial for improving the performance of SMEs in Edo State. The result is supported by Bettoni et al. (2021) , Denicolai et al. (2021) and Sharma et al. (2022). Bettoni et al. (2021) provide a qualitative understanding of the challenges SMEs face in adopting AI, highlighting the importance of accessible and high-quality data for AI integration. Their conceptual framework suggests that addressing data-related issues is crucial for improving AI adoption among SMEs, which aligns with the significant impact data variables have on SME performance as indicated by our regression analysis. In addition, Denicolai et al. (2021) add a quantitative dimension by demonstrating that AI readiness, which includes data readiness, positively influences SME performance on an international scale. This finding supports our hypothesis that data variables significantly impact SME performance, as the ability to leverage data effectively is essential for SMEs to compete globally and improve their overall performance. Sharma et al. (2022) focus on specific AI applications like chatbots and identify factors influencing their adoption, including data-related aspects. Their findings underscore the importance of employees' capability and financial support in managing and utilizing data for AI applications, reinforcing the idea that better data management can enhance SME performance.

Hypothesis two

H0: Computational variables does not have significant impact on the performance of SMEs in Edo State Nigeria.

H1: Computational variables have significant impact on the performance of SMEs in Edo State Nigeria.

Independent variable = Data variables

Dependent variable = Performance of SMEs

Regression analysis was also used to test this hypothesis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	a	b
1	0.355	0.126	0.121	0.41934	24.479(1,170)	0.000	1.202	0.271

The specific regression equation for this model:

Performance of SMEs=1.202 + 0.271 Computational Variables

The analysis of the second hypothesis, "Impact of AI Infrastructures on Small and Medium Enterprises (SMEs) Performance in Edo State, Nigeria," provides significant insights into the role of computational variables. The hypotheses are as follows:

The regression analysis conducted reveals several key points. The correlation coefficient (R) is 0.355, indicating a moderate positive relationship between computational variables and SME performance. This means that as computational variables improve, there is a corresponding improvement in SME performance. The R Square (R^2) value is 0.126, suggesting that approximately 12.6% of the variance in SME performance can be explained by computational variables. The adjusted R Square value of 0.121 confirms this, indicating a slight adjustment for the number of predictors in the model.

The standard error of the estimate is 0.41934, indicating the average distance that the observed values fall from the regression line. This value reflects the fit of the model. The ANOVA (Analysis of Variance) shows an F statistic of 24.479 with a significance level (p-value) of 0.000. This p-value is less than the alpha level (α) of 0.05, indicating that the results are statistically significant. Therefore, we can reject the null hypothesis and accept the alternative hypothesis, concluding that computational variables significantly impact the performance of SMEs in Edo State.

Examining the regression coefficients, the intercept (α) is 1.202, representing the expected mean value of SME performance when all computational variables are zero. The beta coefficient (β) is 0.271, indicating that for every one-unit increase in computational variables, the performance of SMEs increases by 0.271 units, holding all other factors constant.

To put this into perspective, consider that computational variables include measures such as processing power, storage capacity, and internet speed available for AI models within SMEs. A unit improvement in any of these variables (e.g., faster processors, larger data storage, or better internet speed) would result in a 0.271 unit increase in SME performance. For instance, if an SME improves its computational variables by 3 units, the expected increase in performance would be 0.813 units on a performance scale.

Overall, the findings indicate that computational variables have a statistically significant and positive impact on SME performance. Enhancing computational variables within AI infrastructures can lead to improved productivity, profitability, customer satisfaction, and overall business performance for SMEs in Edo State. This suggests that investments in computational resources can provide substantial benefits, helping SMEs leverage AI more effectively to enhance their operations and outcomes.

The result is in line with the findings of Younus (2022) and Strusani & Houngbonon (2019). Younus (2022) examines the impact of AI on job performance in SMEs, highlighting that computational resources are crucial for the effective deployment of AI applications. This supports our hypothesis that computational variables significantly impact SME performance by enabling more efficient and effective AI solutions. Strusani & Houngbonon (2019) emphasize the role of computational resources in maximizing the benefits of AI in developing countries. Their study suggests that sufficient computational infrastructure is essential for leveraging AI to improve business performance and access to markets. Adequate computational resources, including processing power, storage capacity, and internet speed, are critical for the effective deployment of AI applications, leading to improved productivity, efficiency, and overall performance in SMEs.

Summary, Conclusion and Recommendations

Here's a comprehensive summary, conclusion, and recommendations based on the provided research findings:

Summary

This study explored the impact of Artificial Intelligence (AI) infrastructures on the performance of Small and Medium Enterprises (SMEs) in Edo State, Nigeria. Utilizing a survey research design, data were collected from 348 owner-managers, with a 71.2% response rate. The analysis focused on two primary factors: data variables

(including volume, accessibility, and quality) and computational variables (including processing power, storage capacity, and internet bandwidth).

The findings revealed that both data and computational variables significantly impact SME performance. A regression analysis indicated that data variables account for 15.5% of the variance in performance, with each unit increase in data variables resulting in a 0.220 unit increase in performance. Similarly, computational variables explained 12.6% of the variance, with a 0.271 unit increase in performance for each unit improvement in these variables.

The respondents generally perceived AI-related factors positively, indicating that improvements in data access, quality, processing power, and internet connectivity enhance decision-making, operational efficiency, and overall business performance.

Conclusion

The study confirms that AI infrastructures, specifically data and computational variables, significantly contribute to enhancing the performance of SMEs in Edo State, Nigeria. The positive relationships identified between these variables and SME performance suggest that investing in AI-related infrastructures can lead to substantial benefits for small and medium enterprises, improving their productivity, profitability, and competitiveness in an increasingly digital economy.

The findings are consistent with previous literature highlighting the importance of accessible, high-quality data and robust computational resources for effective AI integration in SMEs. As such, addressing the challenges faced by SMEs in leveraging AI can foster their growth and contribute to the broader economic development of the region.

Recommendations

Based on the findings, the following were recommended:

1. Investment in AI Infrastructures: Stakeholders, including government and private sector entities, should invest in developing AI-related infrastructures, such as high-speed internet, robust data management systems, and computational resources. This will empower SMEs to harness AI's potential more effectively.
2. Training and Capacity Building: Implement training programs for SME owners and employees focusing on data management, AI technologies, and computational resources. This can enhance their skills and understanding of how to utilize AI effectively, ultimately improving their business performance.
3. Enhancing Data Quality and Accessibility: Encourage SMEs to adopt best practices for data management to improve data quality, volume, and accessibility. This can involve developing standardized protocols for data collection and management to ensure that AI applications yield reliable and actionable insights.
4. Public-Private Partnerships: Foster partnerships between government agencies and private organizations to facilitate the sharing of resources, knowledge, and best practices related to AI. Such collaborations can help address common challenges faced by SMEs in adopting AI technologies.
5. Policy Support: Governments should develop supportive policies that incentivize SMEs to adopt AI technologies, including financial grants, tax incentives, or subsidies for purchasing AI infrastructure. This can lower the barriers to entry for SMEs looking to integrate AI into their operations.

By implementing these recommendations, stakeholders can enhance the capability of SMEs to leverage AI, thus driving economic growth and fostering innovation within the region.

Suggestions for Further Studies

Further studies should be conducted to explore the specific challenges SMEs face in adopting AI and the long-term impacts of AI integration on their performance. Research could also focus on sector-specific applications of AI to provide tailored recommendations.

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