

RESILIENCE AND LIVABLE CITIES IN A WARMING WORLD



A FESTSCHRIFT IN HONOUR OF
TPL. DR. JOSHUA ADEWUMI ADEBISI FNITP, RTP

EDITED BY



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Nigerian Institute of Town Planners, Oyo State Chapter

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HONOUR OF TPL. DR. JOSHUA ADEWUMI ADEBISI**

Editors:

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SYNERGIZING GLOBAL SYSTEM OF MOBILE COMMUNICATIONS AND ARTIFICIAL INTELLIGENCE FOR INCLUSIVE REGIONAL DEVELOPMENT IN NIGERIA

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Abstract

This study examines the effect of global system of mobile communications (GSM) and artificial intelligence (AI) applications in fostering inclusive regional development. GSM networks have historically bridged communication gaps, enabling access to financial services, healthcare, and education in underserved communities. Building on this foundation, AI technologies introduce advanced capabilities such as predictive analytics, smart agriculture and mobile-based diagnostics. By integrating GSM's widespread connectivity with AI's transformative potential, regions can achieve more equitable growth, enhance service delivery, and strengthen governance. Case studies from Nigeria, Kenya, Uganda, Morocco and South Africa highlights how GSM and AI-powered applications are reshaping the healthcare delivery, agriculture, education, financial and energy sector for regional development. Some of the challenges affecting GSM-AI technology integration in Africa which were highlighted in the article include poor GSM network in rural areas, low digital skills and finance.

Keywords: GSM, Artificial Intelligence, Regional Development, Nigeria

1.0 Introduction

Global System of Mobile Communications (GSM) is a computerized, flexible communication system created by the European Telecommunications Standard Institute (ETSI). The reason for creating GSM was to replace the old analog system with a digital system that works across the whole of Europe. GSM helps with making phone calls, sending texts, and using the internet, which is why it is an important part of global communication (Omoruyi, et.al.2025). Aker and Mbiti (2010) found that GSM technology has been a big change in improving communication, especially in developing countries. In business, it makes things run more smoothly by allowing fast communication, cutting down costs, and helping with real-time decisions (Donner and Escobari, 2010). GSM has also helped with financial activities through mobile banking and payment systems, giving people in areas without traditional banks a way to manage money (Jack and Suri, 2011). The first GSM service was started in 1991 in Finland by a company called OY Radioing AB (Enahoro and Olawade, 2021). Thirty years later, in 2021, about 5 billion people around the world used GSM (Statista, 2020).

In Nigeria, GSM started in May 2001 when the government gave a license to a company from South Africa called MTN to set up a local branch, MTN Nigeria. In August of the same year, another company called Econet, which is now known as Airtel, was also given a license. Two years later, a local company called Globacom was granted a license to join the growing market, and Etisalat, now known as T2, entered in 2008. Among these four companies, MTN has the most users, with about 52.4% as of

2025, followed by Airtel with 33.9%, Globacom with 11.9%, and T2 with less than 2% (www.Intelpoint.com). The start of GSM in Nigeria has helped the country grow by connecting different parts of the economy (Enahoro and Olawade, 2021). Omoruyi et.al.(2025) said that GSM has been very important in Nigeria for improving communication, making things more accessible, and promoting social and economic progress. It has allowed small businesses to thrive by using mobile tools to meet their goals. GSM has also helped connect both rural and urban areas, allowing businesses to reach beyond local markets. It has also encouraged entrepreneurship among Nigerian youth, especially in the informal sector, by giving access to information, networking, and tools that help achieve economic independence (Azubuike and Obiefuna, 2014).

The Nigerian government has recognized the importance of GSM in the country's economic growth and has taken steps to support its use in different areas of the economy. One of those steps is the National Digital Economy Policy and Strategy (2020–2030), which aims to use digital technologies to boost economic growth (Federal Ministry of Communications and Digital Economy, 2020). GSM has helped communication and business across the world, especially in Nigeria. However, as the need for mobile services increases, GSM service providers face challenges in keeping operations efficient, ensuring quality service, and using resources well. This article looks at how artificial intelligence (AI) has helped improve GSM operations and how it has affected regional development. The world is entering an age where power will depend not just on territory, military strength, or international trade, but on stories and the ability to compute. Nations that control data, energy, and the infrastructure behind AI will shape global progress. Those that don't will be shaped by it." (Eziakonwa, 2025). How Africa handles the global competition in the fourth industrial revolution (4.0), especially in AI innovation, will decide the future of millions of people on the continent.

2.0 Literature Review

2.1 Conceptual Review

2.1.1 Artificial Intelligence (AI)

Artificial Intelligence, or AI, is about making machines that can think and act like humans. These machines are designed to imitate human intelligence by learning from experience and solving problems. The term can also describe any machine that shows qualities like learning and problem-solving (African Union Development Agency - NEPAD, 2021). Tiwari, (2024) defines "AI as the branch of computer science that focuses on the creation of intelligent agents, which are systems that perceive their environment and take actions that maximize their chances of successfully achieving their goals". AI involves simulation of cognitive processes that are associated with human intelligence such as problem solving, learning reasoning, language understanding and perception (Harika, et.al. 2022). AI functions by using algorithms and dynamic modeling to process data, make decisions, and learn from outcomes, often exceeding the speed and accuracy of human ability in various tasks (Mienye and Jere, 2024). In AI application, three key features are vital, namely natural language processing (NLP), speech recognition and image recognition (Hirschberg and Manning,

2015; Lu, et.al. 2017). In all the definitions of AI highlighted above, a salient point is the creation of applications that will mimic human intelligence in performing various functions hitherto performed manually by humans.

2.1.2 AI and GSM Operations

AI has become vital in improving GSM networks by providing intelligent automation, predictive analytics, and data-driven decision-making (Sarker, 2021). GSM operations are being transformed through the application of machine learning algorithms to enable predictive maintenance (Bakare and Ekolama, 2023). Neural networks have revolutionized GSM operations by enabling traffic prediction and optimization, which improves the user experience (Hassan, et.al. 2021). Alahi et al., (2023) noted that integration of AI technologies into GSM has brought about great improvement in threat detection. AI enables threat detection in GSM through the use of sophisticated algorithms (Bakare and Ekolama, 2023). AI presents a potentially effective pathway for protecting fraudulent activities and emerging security issues in the continuously evolving telecommunication sector (Abdel et.al., 2022). Customer service experience has been improved through the adoption AI-driven chatbots by the GSM operators which has decreased waiting times and providing more responsive support (Roslan and Ahmad, 2023). The dynamic spectrum sharing (DSS), which is an important AI application has helped in adjusting to changes in GSM network traffic, hence guaranteeing improved service quality in different geographical and temporal situations (Patil et al., 2022). From the foregoing, it is obvious that integration of AI into GSM has improved its functions and performance.

The advancement of GSM in Africa has increased internet access and popularity of mobile devices (Chiswa, 2025). Between 2015 and 2022, the number of internet users in Africa continent doubled to about 570 million (Galal, 2024). The third industrial revolution (3.0) championed by advancement in information and communication technology (ICT) especially GSM and currently, the fourth industrial revolution (4.0), characterized by the convergence of advanced technologies such as the Internet of Things (IoT), Big Data, and Artificial Intelligence (AI) has great potential to impact billions of lives and livelihoods across the world (Chiswa, 2025; Alcácer, and Cruz-Machado, 2019). Since GSM stands as vehicle for quick communication of ideas and innovations that promote regional development, the next section will examine the different sectors of African economy that have benefited from GSM-AI integration.

2.1.3 Environmental Management

AI has big potential in helping manage environmental issues that Africa is facing because of climate change. Problems like flooding, hurricanes, and sand dune growth in the Sahara can be predicted and studied using AI. In South Africa, Tshwane University of Technology created an AI tool that monitors water pipe leaks to cut down on wasted water. This technology can be used by industries, city water companies, and even homes to spot leaks and take action. Another AI app was also developed in South Africa. It's a smartphone tool for garbage collectors that helps them plan their routes and track their work. Citizens can also use the app to report problems in their areas.

This helps drivers finish their routes more quickly and handle more requests (African Union Development Agenc - NEPAD, 2021).

2.1.4 Agriculture

One of the areas in Africa that has seen benefits from AI technologies is agriculture. AI is being used to solve several problems in farming, such as predicting the weather, monitoring soil conditions, automating irrigation, and keeping track of crops. For instance, AI helps in deciding when to plant seeds, how deep to plant them, and when to harvest. It can also detect pests, diseases, and weeds. For example, some robots are used to pick strawberries, and AI helps in identifying grasshoppers, weeds, and figuring out when to use pesticides (African Union Development Agenc - NEPAD, 2021).

In South Africa, an AI-based innovation called Farm Drive is helping smallholder farmers get access to financial services. Farm Drive uses GSM phones and AI machine learning to fill in the gaps in data that stop financial institutions from giving loans to creditworthy farmers. By using the Farm Drive app, farmers can keep track of their income and expenses. The information they provide becomes a reliable source of financial data, which can be used to apply for loans. This helps smallholder farmers get the credit they need, which improves their productivity and overall livelihood. Other startups like IA Precision in Nigeria, Ujuzi Kilimo and Apollo Agriculture in Kenya, and Aerobotics in South Africa are also developing precision agriculture tools that provide farmers with data-driven insights to help them make better decisions and improve their crop yields (Deshpande, 2024).

2.1.5 Transportation

Recent studies are looking at how using AI in urban planning can help solve transportation problems in city areas. For instance, Domingo and others (2024) studied how AI can be used in urban planning and public transport in Johannesburg, South Africa. Their research shows that AI-based traffic systems can help reduce traffic jams and pollution, making cities more livable and environmentally friendly.

2.1.6 Healthcare

AI is the most talked-about topic in healthcare, not just in Africa but around the world. AI tools can help doctors make diagnoses by using image capture and smart computer models before patients even see a doctor (Ogunleye, 2021). Some examples of these tools include the Parasight platform and Excel Scope, which are used for computerized malaria diagnosis (Pharmaccess Foundation, 2015). In Nigeria, there is an app called Aajoh that works with mobile phones. Users can type their symptoms, send photos, or speak into the app for quick diagnosis (<https://www.f6s.com/aajoh>). AI-powered systems are also helping to make it faster to get patient information, process it, make diagnoses, and follow up after treatment.

In Uganda, a company named Global Auto Systems Ltd has created an integrated system for managing cancer patients across different private cancer screening centers. Another AI called Paps AI was developed by a researcher at Mbarara University of Science and Technology (MUST) in Uganda to automatically diagnose and classify

cervical cancer from pap-smear results. AI is being used to predict and manage health issues like cancer, malaria, and birth asphyxia. For example, in rural clinics in Kenya, AI is used to detect cervical cancer. In Kenya, IBM Research is using AI to stop the spread of malaria. In Nigeria, Buena uses AI to find the risk of birth asphyxia (African Union Development Agency-NEPAD, 2021). Telemedicine apps that use AI are changing how healthcare is delivered. These apps allow doctors in cities to help patients in remote areas through online consultations. This is especially important in places that are far from medical centers. AI can also help monitor patients with wearable devices that track important body functions and send alerts to doctors when something might be wrong. This allows for quick medical help before serious problems happen (Mienye et al., 2024). Figure 1 shows how AI is used in different parts of healthcare.

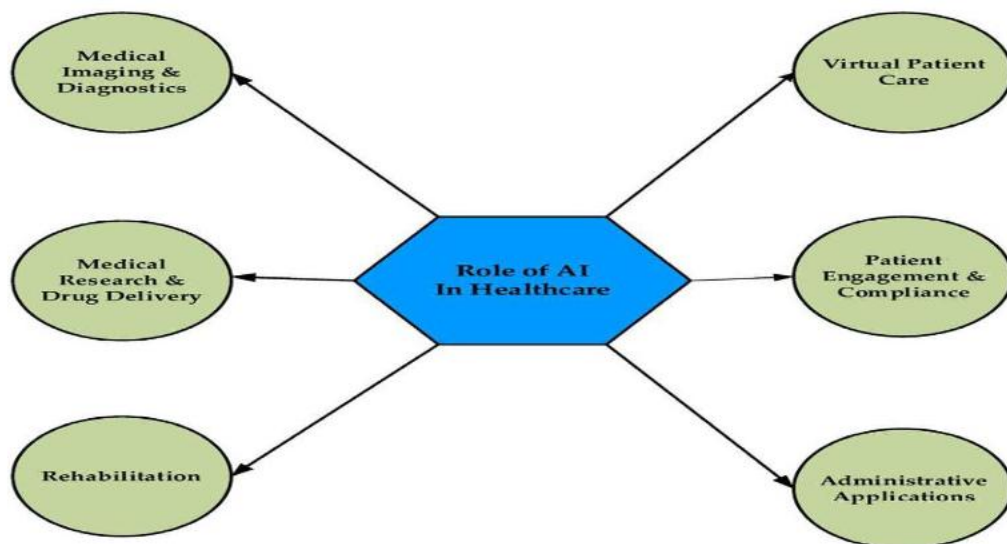


Figure 1: Application of AI in healthcare adapted from Al Kuwaiti et.al. 2023

2.1.7 Energy

Electricity access is a big challenge for Africa's development. Many people on the continent don't have electricity from the main power grid. To solve this, there's a growing focus on renewable energy sources like wind, solar, geothermal, and hydro power to meet the rising energy needs. In the search for better renewable energy solutions, AI is being used in Africa to improve how energy is made, shared, and used. This includes making smart grids and smarter electrical systems. For example, in Morocco, a model called multi-layered perception (MLP) has been created to predict monthly solar radiation. This helps make solar grids work better. In Nigeria, an artificial neural network (ANN) model is used to forecast solar energy levels. In Algeria, mixed learning models are used to predict energy use for heating, cooling, and home appliances. In Nigeria, the deployment of smart utility meters by electricity distribution companies (DISCOs) has helped in resolving issues of energy theft by

customers, inefficient or wrong billing, ineffective allocation of energy resources and high costs of administration (Ogunleye , 2021).

2.1.8 Financial Sector

Boukherouaa et al., (2021) suggested that using AI in financial institutions can help African countries make transactions easier and faster, improve how financial institutions manage risks and detect fraud, which in turn can increase digital sales and transactions. The use of AI has helped African economies grow by lowering the cost of transactions, making financial services more accessible, and ensuring they follow rules and regulations (Tobias, 2024). A South African bank has introduced a robot that talks to customers, offers personalized service, and gives advice by understanding voice and emotions. Other South African companies like Data Prophet and Clevva also use automated advisors to help their clients. In Nigeria, Kudi.ai is making progress by using AI in banking. The company created a chatbot called Kudi that helps customers pay bills, buy airtime, transfer money, check their bank accounts, and get reminders when bills are due. Kudi can be accessed through any messaging app on mobile phones. In Kenya, a 2019 study found that 7% of financial institutions use chatbots for customer service. The study also found that most customers had a positive experience when interacting with chatbots (African Union Development Agency-NEPAD, 2021).

2.1.9 Education

The use of AI in education is considered an important step to improve the quality of education in Africa, where access to learning is not equal (Arakpogun, et al.2021; Goralski and Tan, 2023).AI technologies can make learning better by offering personalized learning and helping with language translation. These technologies provide solutions that can deal with some of the big problems in education systems across the continent (Mienye et al., 2024). Gligorea et al. (2023) say that AI can customize educational content and tests to match each student's needs by looking at their performance and learning habits, which helps students engage more and learn better. For example, in South Africa, a program called Siyaphumelela has been started to use data analysis to help students succeed. This project involves five universities: University of Pretoria (UP), Durban University of Technology (DUT), University of Witwatersrand (WITS), Nelson Mandela University (NMU), and University of Free State (UFS). The project is supported by the Kresge Foundation to collect and analyze student data to help with academic success. This learning analytics is used to predict when students might fail and to put in place support systems to help them succeed. Similarly, the University of Port Harcourt in Nigeria also uses learning analytics to predict student failure (African Union Development Agency-NEPAD, 2021). In Nigeria, AI has also been used in areas like data collection, data analysis, citation and referencing, creating PowerPoint presentations, virtual classrooms, assessments and grading, virtual science labs, and YouTube AI channels. These tools all help improve learning outcomes.

Some of the AI tools that have been used include:

- i. SurveySparrow: AI-powered survey tool with conversational surveys.

- ii. Qualtrics XM: AI-enhanced platform for surveys, interviews, and real-time feedback.
- iii. KOBToolbox: AI-supported data collection for field research.
- iv. Typeform: AI-based tool for interactive and engaging data collection
- v. Magicschool: AI assistant for tailoring lesson plans and classroom resources automatically.
- vi. Pear Deck: AI-powered tool that enhances lesson delivery by integrating interactive elements such as polls, quizzes and student responses into presentations.
- vii. Curipod: AI-powered platform designed to help educators create interactive lesson activities and presentations
- viii. Zotero: AI-assisted reference manager that organizes and formats citations.
- ix. Mendeley: AI-enhanced tool for reference management and paper annotation.
- x. JCiteThisForMe: AI-powered automatic citation generator in multiple formats.
- xi. EndNote: AI-powered citation management with smart formatting features (Fomsi,2025)

Meanwhile, most countries in Africa are made up of different ethnic groups, each speaking their own language. AI has the ability to help break down language barriers that are common in Africa because of the many languages spoken there. AI-powered translation tools can turn educational materials into various local languages, making learning easier for everyone. This is especially important in areas where there are not enough educational resources in local languages (Mienye et al., 2024). For example, the African Languages Technology Initiative in Nigeria worked with Microsoft to adapt Windows and Office for Hausa, Igbo, and Yoruba, which are three main languages spoken in Nigeria (Adekanmbi, 2018).

Artificial intelligence application in various sectors of African economy is not only limited to the above highlighted sectors. Al-Baity (2023) noted that AI plays important role in meeting the Sustainable Development Goals (SDGs). As demonstrated in Figure 2, the SDG goals such as SDG1 (No poverty), SDG2 (zero hunger), SDG3 (Good health and wellbeing), SDG4 (Quality education), SDG5 (Gender equality), SDG6 (Clean water and sanitation), SDG7 (Affordable and clean energy), SDG9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action) could be achieved by integration of AI.

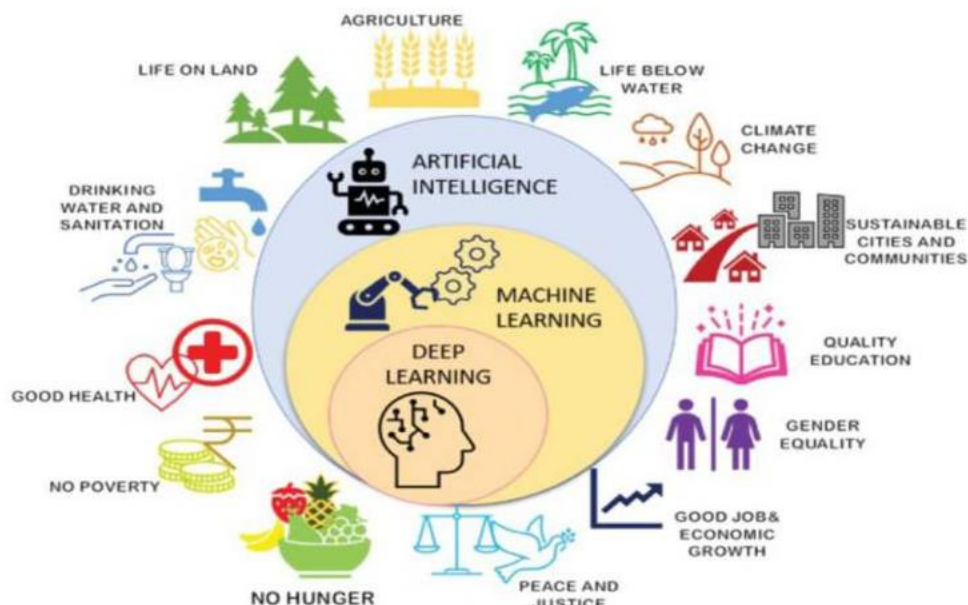


Figure 2: AI and its subsets driving SDG (Al-Baity, 2023).

4.0 Barriers to GSM and AI Integration for Regional Development in Africa

Despite the remarkable progress made in GSM adoption in the continent, there are still some challenges that limit its full exploitation. For instance, network penetration in remote areas is still low compared to the urban centres. Most GSM operators concentrate in the urban centres where large volume of calls is recorded daily, with little attention given to the rural areas. The poor network quality in rural areas hinders the use of AI applications powered by mobile devices especially for agricultural purposes, which is the backbone of rural economy. Another challenge is that digital illiteracy is still high in Africa. The basic skills required in operating GSM and AI technologies is lacking among large percentage of the population especially in rural areas. Data challenge is another problem AI is facing in Africa. AI needs strong data collection systems that use many sensors and satellites to constantly collect accurate and complete environmental information. This can be hard for African countries to set up because they may not have enough money.

Also, a lot of computing power is needed to process the data, which can be a problem in areas of Africa that don't have good computer facilities. A major challenge facing AI currently is that of accuracy, which is dependent on the data the system is trained on. This means that an AI system is as good as the data it learns from and African nations presently do not have resources to invest in data centres compared to what is obtainable in the advanced economies where billions of dollars are being budgeted for AI infrastructure. Nevertheless, progress is being made in some African countries with respect to establishment of AI start-ups. Most of these AI start-ups are found in South Africa, Kenya, Egypt, Nigeria, and Tunisia, with more than 5 start-up companies recorded (African Union Development Agency-NEPAD, 2021).

5.0 Conclusion

There is overwhelming evidence that the intersection of GSM technology and AI applications is transforming the socio-economic development of nations and regional development in Africa. There is no sector of the economy in this 21st century that is immune from the impact of telecommunications and artificial intelligence. Thus, African nations should brace up in harnessing GSM and AI-based technologies for their economic and regional development. The impacts of AI on education, healthcare, agriculture, financial sector, energy and transportation were considered in this article. It is evident that AI technologies are transforming the way things are done which have direct consequences on economy and regional development. Therefore, African leaders need to adopt a comprehensive approach considering the emerging technologies' broader societal implications. In this sense, countries can incorporate the development and implementation of AI into their regional development strategies. Some of the barriers that hinder GSM and AI application in Africa include poor GSM network in rural areas, low digital skills, infrastructure and finance. In this regard, governments should scale-up tele-density in the rural areas by assisting the GSM network providers with incentives and other necessary infrastructure.

In terms of AI, the nature of education and structure of curricula for the schooling system in Africa must be fashioned towards AI technologies. Starting from primary education level, pupils should be taught the basic AI technologies. Lastly, African Nations should treat investment in AI technologies as national priority by including it in the annual budget like other sectors (defense, health, agriculture etc.).

References

- Abdel Hakeem, S. A., Hussein, H. H., & Kim, H. (2022). Security requirements and challenges of 6G technologies and applications. *Sensors*, 22(5), 1969.
- Adekanmbi, O (2018). AI Simplified: 99 Use Cases and Expert Thoughts for Starters. Published by Data Science Nigeria, Lagos
- African Union Development Agency-NEPAD, (2021). AI for Africa: Artificial Intelligence For Africa's Socio-Economic Development. APET REPORT
- Aker, J. C., & Mbiti, I. M. (2010). Mobile Phones and Economic Development in Africa. *Journal of Economic Perspectives*, 24(3), 207–232. doi: 10.1257/jep.24.3.207
- Al Kuwaiti, A., Nazer, K., Al-Reedy, A., Al-Shehri, S., Al-Muhanna, A., Subbarayalu, A.V., et al. (2023). A review of the role of artificial intelligence in healthcare *Journal of Personalized Medicine*, 13, <http://dx.doi.org/10.3390/jpm13060951>, URL: <https://www.mdpi.com/2075-4426/13/6/951>.
- Alahi, M. E. E., Sukkuea, A., Tina, F. W., Nag, A., Kurdthongmee, W., Suwannarat, K., & Mukhopadhyay, S. C. (2023). Integration of IoT-Enabled Technologies and Artificial Intelligence (AI) for Smart City Scenario: Recent Advancements and Future Trends. *Sensors*, 23(11), 5206
- Al-Baity, H. H. (2023). The artificial intelligence revolution in digital finance in Saudi Arabia: A comprehensive review and proposed framework. *Sustainability*, 15, <http://dx.doi.org/10.3390/su151813725>, URL: <https://www.mdpi.com/2071-1050/15/18/13725>
- Alcácer, V.; Cruz-Machado, V. (2019). Scanning the Industry 4.0: A Literature Review on Technologies for Manufacturing Systems. *Eng.Sci. Technol. Int. J*, 22, 13–30.

- Azubuike, C., & Obiefuna, O. (2014). Wireless Communication: The Impact of Gsm on the Economic Lives of the Nigerian Rural Users. *Journal of Educational and Social Research*. doi: 10.5901/jesr.2014.v4n7p79
- Bakare, B. I., Ekanem, I., & Allen, I. O. (2017). Appraisal of Global System for Mobile Communication (GSM) in Nigeria. *American Journal of Engineering Research (AJER)*.
- Bakare, B. I. and Ekolama, M. S. (2023). Application of Artificial Intelligence (AI) to GSM Operations. *European Journal of Science, Innovation and Technology*, Vol. 3, No. 6
- Boukherouaa, E., AlAjmi, K., Deodoro, J., Farias, A., Ravikumar, R. (2021). Powering the digital economy: Opportunities and risks of artificial intelligence in finance. *International Monetary Fund*.
- Chiswa, N. (2025). Realizing Africa's Promise: The Role of Artificial Intelligence and Blockchain Technology in Achieving the Objectives of the African Continental Free Trade Area. *Sustainability and Climate Change*. Vol. 18 No. 2, DOI: 10.1089/scc.2025.0006
- Deshpande, T. (2024). Understanding AI for sustainable development in Africa
- Donner, J., and Escobari, M. X. (2010). A review of evidence on mobile use by micro and small enterprises in developing countries. *Journal of International Development*, 22(5), 641–658. doi: 10.1002/jid.1717
- Enahoro, M. A. and Olawade, D. B. (2021). GSM and the Nigerian Economy: The Journey from 2004 to 2019. *International Journal of Economics and Finance*; Vol. 13, No. 7
- Eziakonwa, A. (2025). Africa's AI Moment: Build the Infrastructure, Own the Future. *UNDP Africa Region*
- Federal Ministry of Communications and Digital Economy. (2020). *National Digital Economy Policy and Strategy (2020–2030)*. Retrieved from <https://ncc.gov.ng/accessible/documents/883-national-digital-economy-policy-and-strategy/file>
- Fomsi, E. F. (2025). *Artificial intelligence and global scientific and technological innovation* [Keynote speech]. Artificial Intelligence & Global Scientific and Technological Innovation Conference, Faculty of Natural and Applied Sciences, Ignatius Ajuru University of Education
- Galal, S. (2024, January 10). Internet usage in Africa—Statistics & facts. Statista. Available from: <https://www.statista.com/topics/9813/internet-usage-in-africa/>
- Harika, J., Baleeshwar, P., Navya, K., Shanmugasundaram, H. (2022). A review on artificial intelligence with deep human reasoning. In *2022 international conference on applied artificial intelligence and computing* (pp. 81–84). IEEE.
- Hassan, A. N., Al-Chlahawi, S., Khekan, A. R. (2021). Artificial intelligence techniques over the fifth generation (5G) mobile networks. *Indonesian Journal of Electrical Engineering and Computer Science*, 24(1), 317–328
- Hirschberg, J., & Manning, C. D. (2015). Advances in natural language processing. *Science*, 349, 261–266.
- Jack, W., & Suri, T. (2011, January). *Mobile money: The economics of M-PESA*. Retrieved from https://www.nber.org/system/files/working_papers/w16721/w16721.pdf
- Lu, L., Zheng, Y., Carneiro, G., & Yang, L. (2017). Deep learning and convolutional neural networks for medical image computing. *Advances in Computer Vision and Pattern Recognition*, 10, 978–3.
- Mienye, I. D., and Jere, N. (2024c). A survey of decision trees: Concepts, algorithms, and applications. *IEEE Access*, 12, 8671686727. <http://dx.doi.org/10.1109/ACCESS.2024.3416838>
- Mienye, I. D., Sun, Y., Ileberi, E. (2024). Artificial intelligence and sustainable development in Africa: A comprehensive review. *Machine Learning with Applications* 18, 100591
- Ogunleye, I. (2021). Artificial Intelligence for Economic Development In Nigeria. Taraaz and the CITRIS Policy Lab's 2021 Technology and Human Rights fellowship program.
- Patil, A., Iyer, S., Lopez, O. L., Pandya, R. J., Pai, K., Kalla, A., & Kallimani, R. (2022). A comprehensive survey on spectrum sharing techniques for 5G/B5G intelligent wireless networks: Opportunities, challenges and future research directions. *arXiv preprint arXiv:2211.08956*
- Pharmaccess Foundation (2015). *Nigerian Health Sector, Market Study Report* https://www.rvo.nl/sites/default/files/Market_Study_Health_Nigeria.pdf

- Roslan, F. A. B. M., & Ahmad, N. B. (2023). The Rise of AI-Powered Voice Assistants: Analyzing Their Transformative Impact on Modern Customer Service Paradigms and Consumer Expectations. *Quarterly Journal of Emerging Technologies and Innovations*, 8(3), 33-64
- Sarker, I. H. (2022). AI-based modeling: techniques, applications and research issues towards automation, intelligent and smart systems. *SN Computer Science*, 3, 158
- Tiwari, S. (2024). The rise of intelligent machines: An introduction to artificial intelligence. In *Artificial intelligence and machine learning in drug design and development* (pp. 1–22).
- Tobias, Adrian, (2024). Artificial Intelligence and its Impact on Financial Markets and Financial Stability, International Monetary Fund 2024, <https://www.imf.org/en/News/Articles/2024/09/06/sp090624-artificial-intelligence-and-its-impact-on-financial-markets-and-financial-stability>.