Research Centre Publication

ROME BUSINESS SCHOOL

BETTER MANAGERS FOR A BETTER WORLD

DIGITALISATION AND ARTIFICIAL INTELLIGENCE

IN NIGERIA

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INTRODUCTION

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Introduction

The Fourth Industrial Revolution has been characterised by digital transformation or digitalisation as a core aspect of industry-wide operations and strategies globally. Researchers describe it as an engine for economic development as digitally transformed firms report soaring contributions to the global GDP. The principal elements of digitalisation are digital technologies which are central to disruptive and reinforcing changes at industry levels.

These elements may either be industry-specific (such as BIM in construction, additive manufacturing in manufacturing, CRM in retail, and LMS in education) or generally adaptable (such as Artificial Intelligence, drones, Blockchain, Extended Reality, robotics, and GPS). In Nigeria, digitalisation and AI are irrefutably at their nascent stage of adoption with the incursion of digital technologies into certain industries. This incursion is driven by global competition but also remarkably by the young (tech-savvy) population.

The digitalisation agenda has also received some support from local stakeholders such as the government and private investors. For instance, the Nigerian government provided the National Digital Economy Policy and Strategy that drives towards a more sustainable digital economy. These have been accompanied by other efforts such as skill training programmes and the digital trade protocol.

As such, several success stories of digitalisation and AI adoption have been recorded across GDP-contributing sectors such as retail, agriculture, and banking. These technologies have been employed in these respective industries to analyse customer behaviour patterns, track crop health and diagnose crop diseases, serve undeserved or hard-to-reach communities, and detect financial fraud. Besides this, more generally, digitalisation and AI adoption have improved efficiency, accorded informed decision-making, provided cost-saving benefits, enhanced customer experience, increased competitiveness, created jobs, and by extension, induced economic growth. These are founded on some of the features that automate tasks, streamline features, analyse data, reduce operational costs, optimise resources, and personalise services.

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Calderon-Monge, E. and Ribeiro-Soriano, D., 2023. The role of digitalization in business and management: a systematic literature review. *Review of Managerial Science*, 18(2), pp.449–491. https://doi.org/10.1007/s11846-023-00647-8.

Ciarli, T., Kenney, M., Massini, S. and Piscitello, L., 2021. Digital technologies, innovation, and skills: Emerging trajectories and challenges. *Research Policy*, 50(7), p.104289. https://doi.org/10.1016/j.respol.2021.104289.

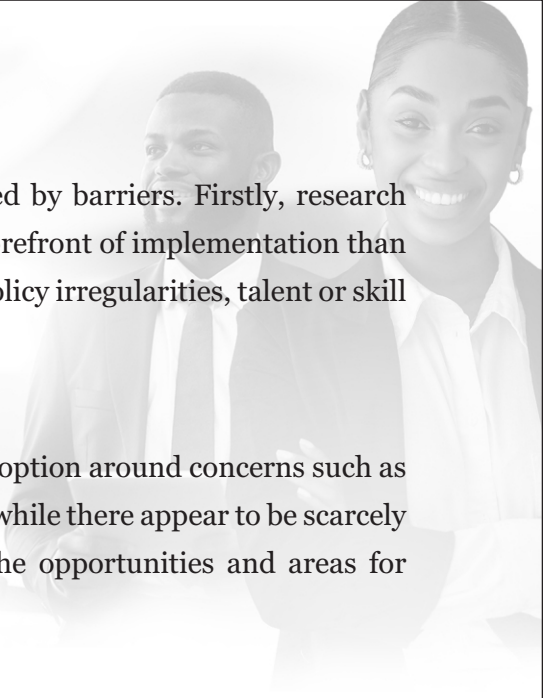
Verhoef, P.C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N. and Haenlein, M., 2021. Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, pp.889–901. https://doi.org/10.1016/j.jbusres.2019.09.022.

Olayinka, O. and Wynn, M.G., 2022. Digital transformation in the Nigerian small business sector. In *Handbook of Research on Digital Transformation, Industry Use Cases, and the Impact of Disruptive Technologies* (pp. 359-382). IGI Global.

Arinze, E.D., 2024. The Impact of Digital Innovation on Economic Growth in Nigeria. *Idosr Journal of Computer and Applied Sciences*, 9(2), pp.1–9. https://doi.org/10.59298/jcas/2024/92.1900.

Michael, C. 2024. *International Youth Day: Nigerian youths in the digital revolution for sustainable development* -Businessday NG. Available at: https://businessday.ng/features/article/international-youth-day-nigerian-youths-in-the-digital-revolution-for-sustainable-development/

Federal Ministry of Communications and Digital Economy, 2019. *National Digital Economy Policy and Strategy*. Nigerian Economic Summit Group.



Nevertheless, digitalisation efforts across these industries are impaired by barriers. Firstly, research shows that some industries are reportedly more progressive or at the forefront of implementation than others bringing to the fore impediments such as resistance to change, policy irregularities, talent or skill gaps, digital infrastructure deficit, and under investment.

In addition, there has been discourse raised on ethical digital and AI adoption around concerns such as data security and privacy, transparency, bias, and accountability. And while there appear to be scarcely any concrete avenues to address these challenges, they pronounce the opportunities and areas for improvement for the future of businesses, investors, and stakeholders.

This paper, therefore, examines digitalisation and Artificial Intelligence in Nigeria focusing on the digital reality of the Nigerian business environment.

The paper presents findings from the Nigerian scene on the leading sectors of digitalisation and AI adoption and how the digital elements have impacted the sectors. These are substantiated by success stories obtainable from industries.

Finally, a ranking of industry/sector adoption is provided as a road map for future investment.

Onwudiegwu, O.A., 2024. Digital Disruption in the Banking and Financial Sector: Creating a Sustainable Framework for the Future of Banking in Nigeria. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4826792.

Abiri, R., Rizan, N., Balasundram, S.K., Shahbazi, A.B. and Abdul-Hamid, H., 2023. Application of digital technologies for ensuring agricultural productivity. *Heliyon*, 9(12), p.e22601. https://doi.org/10.1016/j.heliyon.2023.e22601.

Singh, P., Khoshaim, L., Nuwisser, B. and Alhassan, I., 2024. How Information Technology (IT) Is Shaping Consumer Behavior in the Digital Age: A Systematic Review and Future Research Directions. *Sustainability*, 16(4), p.1556. https://doi.org/10.3390/su16041556.

Nazari, Z. and Musilek, P., 2023. Impact of Digital Transformation on the Energy Sector: A Review. *Algorithms*, 16(4), p.211. https://doi.org/10.3390/a16040211.

Salamah, E., Alzubi, A. and Yinal, A., 2023. Unveiling the Impact of Digitalization on Supply Chain Performance in the Post-COVID-19 Era: The Mediating Role of Supply Chain Integration and Efficiency. *Sustainability*, 16(1), p.304. https://doi.org/10.3390/su16010304.

Okoye, N.S., Uchenna, T.U. and Okechukwu, I.E., 2023. Addressing digital technology gap challenges: The Nigerian experience. *NG Journal of Social Development*, *11*(1), pp.95-100.

Idowu, A.O., Aigbavboa, C. and Oke, A.E., 2023. Barriers to digitalization in the Nigerian construction industry. In: *Computing in Construction*. [online] European Council for Computing in Construction. Available at: <http://dx.doi.org/10.35490/ec3.2023.196> [Accessed 29 November 2024].

Ibrahim, I.A., 2018. Nigeria's Ethical Issues in the Use of ICT. *ITNOW*, 60(2), pp.12–13. https://doi.org/10.1093/itnow/bwy035.

Abiodun, O.O., 2024. Ethical Issues in Digital Marketing in an Emerging Economy: a Perspective of Customers in the Nigerian Banking Industry. *ISRG Journal of Economics, Business & Management* , 2(4),

PART ONE

Part One: Is Digital Technology a Reality in Nigerian Businesses?

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Part One: Is Digital Technology a Reality in Nigerian Businesses?

Digital technology is increasingly becoming a reality in Nigerian businesses. This is evident with the adoption of digital technologies across various sectors, further contributing to the digital economy. Business sectors such as finance and telecommunications are the leading digitalised industries that have continuously implemented technologies to enhance services and customer engagement.

Nevertheless, there is still progress to be made, as several sectors such as agriculture are yet to embrace the digital opportunities within the industry. According to a World Bank assessment, Nigeria is using only a fraction of its digital economic potential and needs a more strategic investment to develop a dynamic, transformative digital economy.

1.1 Early steps towards adoption and current trends The adoption of digital technology and artificial intelligence in Nigeria has influenced many industries, transforming the overall operation techniques. Nigerian industries are gradually adopting digital technology to improve on their operations and overall economic stance.

The evolution of digital technology adoption in Nigerian businesses began with several foundational steps. Initially, the focus was on improving digital infrastructure, particularly broadband connectivity. Broadband, which is the key enabler to maximising digital economy transformation in the country, is poor at this time, with the fixed broadband penetration rate being below the African regional average[3]. Internet access in Nigeria is by wireless mobile network which leads to miserably low internet penetration in the country.

Consequently, the Nigerian Communications Commission (NCC) proposed the transition to a digital economy through investments in digital infrastructure, especially broadband.

This was an effort to improve the mechanisms of digitalisation within the market for efficient industry allocation, enabled infrastructure sharing, and reduced maintenance duties on digital devices. These measures aimed to make digital technologies more accessible, especially in rural and undeserved areas.

Agarwal. P, 2024. *The digital ecosystem in Nigeria and the AfCFTA Digital Trade Protocol: raising awareness and strategising implementation*. ODI Policy Brief. London: ODI .

The World Bank Group

WorldBank Group. 2019. Nigeria digital economy diagnostic report. Available at: https://documents1.worldbank.org/curated/en/387871574812599817/pdf/Nigeria-Digital-Economy-Diagnostic-Report.pdf

Recently, the digital infrastructure in Nigeria has significantly improved, with fixed broadband subscribers increasing from 5% to 19% of the population between 2008 and 2021, and broadband penetration increasing to 43.08%.. During this period, exports of ICT services grew due to sector expansion and policy changes, while imports fluctuated, with a peak in 2014 and then declining due to increased domestic production.

Despite low shares, exports and imports of ICT goods declined over the same period. Domestically, the ICT sector's contribution to Nigeria's GDP increased from 8.1% to 10.3% between 2020 and 2022, with its value rising by 27% to $55.4 billion. Additionally, the productivity of ICT workers grew by 48%, significantly outpacing the overall worker productivity in Nigeria.

The reality of digitalisation in Nigeria is the stability of broadband connectivity which is fundamental in using digital technology for businesses. As a result, several industries have adopted suitable digital technology and continued to advance for improved business outcomes.

The finance and telecommunications sectors were the first to adopt digital technologies in Nigeria. These industries first recognised the potential of digital transformation and have been at the forefront of integrating advanced technologies to enhance their services and customer engagement.

The early effect of digitalisation in the Nigerian banking sector was visible in the disappearance of tally numbers, which was the custom in banking halls. This transitioned into the introduction of Automated-Teller Machines (ATM) to improve customer experiences. CitiBank introduced an online banking platform to its customers in 1999 which was negatively impacted by the poor communication infrastructure .

Today, with the increased stability of broadband connectivity, fintech companies like Paystack and Flutterwave, have revolutionised digital payments and financial inclusion. About 32% of financial service providers have integrated AI technologies and algorithms into their operations, simplifying and accomplishing tasks within the shortest possible time .

Faraafrica (2021). Digitalization in Agriculture, Food and Nutrition - A Case Study of Nigeria - FARA Publications. [online] FARA Publications. Available at: https://library.faraafrica.org/2021/01/13/digitalization-in-agriculture-food-and-nutrition-a-case-study-of-nigeria/ [Accessed 28 Nov. 2024].
World Bank Group. 2019. Nigeria digital economy diagnostic: A plan for building Nigeria's inclusive digital future. Available at: https://www.worldbank.org/en/country/nigeria/publication/nigeria-digital-economy-diagnostic-a-plan-for-building-nigerias-inclusive-digital-future?form=MG0AV3
Bello, M. (2024). Industry Statistics. [online] Ncc.gov.ng. Available at: https://www.ncc.gov.ng/statistics-reports/industry-overview#annual-2012-2023 [Accessed 28 Nov. 2024].
Agarwal. P, 2024. *The digital ecosystem in Nigeria and the AfCFTA Digital Trade Protocol: raising awareness and strategising implementation*. ODI Policy Brief. London: ODI

Agarwal. P, 2024. *The digital ecosystem in Nigeria and the AfCFTA Digital Trade Protocol: raising awareness and strategising implementation*. ODI Policy Brief. London: ODI

Over the past decade, the banking sector has witnessed significant adoption of AI technologies across different phases due to the technological advancement in the country. Across the financial sector, AI has been found useful in credit scoring, fraud detection and personalised experience through chatbots and robo-advisors9. AI technologies such as predictive analytics, recommendation engines, voice recognition and response are of significant usage in replacing traditional treasury management systems (TMS) which are slow to detect money laundering .

The telecommunication sector, regarded as one of the nation's economic pillars, is poised to have significantly adopted digital technology, leading to a positive impact beyond the sector. Some noticeable developments associated with this include the increased and improved digital payment solution, online marketing leading to rapidly growing e-commerce and creating new entrepreneurial opportunities , .

The telecommunications industry continues to expand broadband connectivity and mobile penetration, laying the groundwork for broader digital adoption across various sectors.

Although the agricultural sector was slow in adopting digital technology in Nigeria, digital technology has become visible in the agricultural sector leading to a reduced role of middlemen, providing farmers the opportunity to expand their markets, overall productivity, and livelihood for small-scale farmers[4,]. Mobile applications and web-based tools are available to farmers to influence productivity at the farm and national level, driving the growth of the agricultural sector in Nigeria.

The increasing demand in the agricultural sector as a way of boosting the economic sector contributed to the demand for digital farming practices, driving key stakeholders to introduce digitalisation into the sector. This effort led to Nigeria having a 49.7% in the World Bank's Enabling Business of Agriculture score, and an ICT index score of 4.5 out of 9. The impact of digitisation was also felt in the education sector which, over the years, has moved from the traditional mode of teaching to incorporate technology in education. Traditional schools in Nigeria now offer online classes and online degrees through e-learning using video conferencing platforms such as Google Meet, Zoom, and other chat tools. This has enhanced the breaking of geographical barriers, which have long prevented students from attending certain institutions. The use of cloud-based learning tools also served as a means for teachers and lecturers to host and post videos for students.

https://journals.jozacpublishers.com/jet/
Samuel-Ogbu, I. (2022). Digital Technology and the Transformation of the Nigerian Banking System: the Operators' Perspective. Number 4 Article, [online] 60(4), pp.12–2022. Available at: https://dc.cbn.gov.ng/cgi/viewcontent.cgi?article=2090&context=efr [Accessed 27 Nov. 2024].
World Bank Group. 2019. Nigeria digital economy diagnostic: A plan for building Nigeria's inclusive digital future. Available at: https://www.worldbank.org/en/country/nigeria/publication/nigeria-digital-economy-diagnostic-a-plan-for-building-nigerias-inclusive-digital-future?form=MG0AV3
Ukpong, E. (2022). Integration of Artificial Intelligence Applications for Financial Process Innovation by Commercial Banks in Nigeria. [online] Available at: https://aksujacog.org.ng/articles/22/04/integration-of-artificial-intelligence-applications-for-financial-process-innovation-by-commercial-banks-in-nigeria/aksujacog_02_01_09.pdf.
Charles, R. (2019). Artificial Intelligence in Nigeria Financial Sector. I.J. of Electronics and Information Engineering, [online] 11(1), pp.40–47. doi:https://doi.org/10.6636/IJEIE.201909.
Olawade, D., Pol, F., Lim, C., Enahoro, M. and Lim, C. (2021). THE NIGERIAN TELECOMMUNICATIONS INDUSTRY: THE PAST, PRESENT AND FUTURE. International Journal of Future Generation Communication and Networking, 14(1), pp.45–58. doi:https://doi.org/10.33832/ijfgcn.2021.14.1.05.
Agbai, E. and Okey, U. (2024). Strategic Leadership in the Nigerian Telecommunication Industry: Case Study Analysis. Universal Library of Business and Economics, 01(02), pp.01–09. doi:https://doi.org/10.70315/uloap.ulbec.2024.0102001.

However, the wave of digitalisation is not restricted to higher institutions as the federal government of Nigeria has developed and approved plans to ensure a satellite-based education system at Basic schools across the federation .

Businesses across different sectors are becoming more aware of the economic benefit of digitalisation and Nigeria is among the largest economies in Africa undergoing significant digital transformation. The Digital Transformation Market size is estimated at $9.91 billion in 2024 and expected to reach $22.82 billion by 2029 , and the artificial intelligence market is also estimated at $1.05 billion in 2024 and projected to reach $4.64 billion in 2030 .

However, despite the growth and benefits digitalisation has brought to the different sectors, there are some challenges attributed to the implementation. The influx of artificial intelligence investment in the financial sector, for instance, has led to the question of data security and transparency9.

1.2 The driving forces towards digital technology

The adoption of digital technologies is essential for businesses seeking to remain competitive in today's rapidly evolving landscape. This process, however, is not straightforward but entails a comprehensive journey involving the integration of digital solutions, a fundamental reassessment of business strategies, and efforts to ensure operational continuity .

In the Nigerian context, it has been argued that there are three primary and major drivers towards digital technology, which include the imperative to enhance competitiveness, boost organisational performance, and safeguard sustainability .

However, another school of thought believes that the major drivers of digital technology are servitisation and visualisation . This driving force towards digital technology is influenced by a range of internal and external factors that serve as triggers, pushing organizations toward digital adoption. These driving forces can be broadly categorized into customer demands, technological advancements, and organizational growth. Each plays a pivotal role in compelling businesses to adapt to the digital evolution within their industry. A clear understanding of these drivers is critical for navigating the transformation process and achieving successful outcomes.

https://nitda.gov.ng/wp-content/uploads/2020/11/National-Digital-Economy-Policy-and-Strategy2.pdf?form=MG0AV3
Chibuzo Uzoma Izuogu, Loveday Chukwudi Njoku, Michael Olatunji Olaolu, Philomina Chinyere Kadurumba, Gillian Chidozie Azuamairo and Gabriel Daniel Agou (2023). A Review of the Digitalization of Agriculture in Nigeria. Journal of Agricultural Extension, 27(2), pp.47–64. doi:https://doi.org/10.4314/jae.v27i2.5.
Osunmakinde, M., Abdulkadir, A. and Olatundun, S. (2023). Digitalization of Agriculture: what relevance and challenges in enhancing Climate Smart Agriculture in Nigeria. FARA Research Report, [online] 7(7), pp.48–58. doi:https://doi.org/10.59101/frr072307.
Onyia, M.N. (Ph D.) (2021). Digitization of Education in Nigeria: A Path to Technological Advancement. open.library.okstate.edu. [online] Available at: https://open.library.okstate.edu/adect2021/chapter/digitization-of-education-in-nigeria-a-path-to-technological-advancement/ [Accessed 18 Apr. 2023].
Jacob, N., Abubakar, J. and Abdulrazak, A. (2024). View of Digitalization of Educational Institutions in Nigeria: Benefits, Problems and Solutions. [online] Semanticjournals.org. Available at: http://wos.semanticjournals.org/index.php/JPL/article/view/2/2 [Accessed 29 Nov. 2024].

However, looking at the Nigeria context on which this study is focused, the drivers which will be explored are servitization, technological advancements, and organizational growth. These drivers can be generalised in the Nigerian business environment.

To begin with, servitisation refers to the process by which businesses shift their focus from merely selling products to providing integrated solutions that combine products and services. It involves offering value-added services alongside or instead of physical goods to meet customer needs more comprehensively, creating a more sustainable and customer-centric business model .

The progression toward servitisation serves as a significant driving force for digital technology, particularly within the realm of after-sales services. On the one hand, digital technology functions as a technological enabler in front-end processes, empowering businesses to respond effectively to evolving customer demands and expectations. On the other hand, within back-end processes, digital transformation offers a strategic opportunity to enhance internal operational efficiency and mitigate cost pressures arising from servitization requirements.

Together, these dynamics underscore the critical role of digital transformation in aligning organizational capabilities with the demands of a serviced business model. Furthermore, digital technology has significantly impacted various sectors of the global economic system, notably the financial sector. Recognized as a pivotal driver of digital economy development, the financial sector ranks second only to telecommunications companies in terms of investments in cutting-edge information and communication technologies in enhancing servitization [45]

Narrowing it down to the Nigerian banking industry, the sector has increasingly integrated technology into its strategic framework, aiming to achieve significant benefits from digitalization in order to enhance servitization. This has further resulted in the reduction of operational costs, minimizing risks, decreasing reliance on cash transactions, and enhancing the adoption and value of electronic payment systems. Additionally, this shift has driven the transformation of traditional banking models, paving the way for the emergence and growth of FinTech enterprises[46] . The next is technological advancements. This has emerged as a fundamental component of organizational success in today's competitive business landscape.

Ukozor, C.U. and Muhammad, S. (2024). Digitalization of Basic Education in Nigeria: Problems and Way Forward. European Journal of Artificial Intelligence and Digital Economy, [online] 1(2), pp.39–48. doi:https://doi.org/10.61796/jaide.v1i2.213.
Mordor Intelligence (2024). Nigeria Digital Transformation Market Size & Share Analysis - Industry Research Report - Growth Trends. [online] Mordorintelligence.com. Available at: https://www.mordorintelligence.com/industry-reports/nigeria-digital-transformation-market [Accessed 27 Nov. 2024].
Statista (2024). Artificial Intelligence - Nigeria | Market Forecast. [online] Statista. Available at: https://www.statista.com/outlook/tmo/artificial-intelligence/nigeria [Accessed 27 Nov. 2024].
Dabab, M., & Weber, C. (2018). Business intelligence and data analytics as a driver of dynamic capability strategic approach. PICMET 2018 - Portland International Conference on Management of Engineering and Technology: Managing Technological Entrepreneurship: The Engine for Economic Growth, Proceedings, 1–9. 10.23919/PICMET.2018.8481750
Mihu, Cantemir & Pitic, Antoniu & Bayraktar, Dorin. (2023). Drivers of Digital Transformation and their Impact on Organizational Management. Studies in Business and Economics. 18. 149-170. 10.2478/sbe-2023-0009.
Dombrowski, U., and Fochler, S. 2018. Servitization as a key driver for Digital Transformation of manufacturing companies' Spare Parts Service. Proceedings of the 2018 IEEE International Conference on Service Operations and Logistics, and

The need and use for advanced digital technologies, like the Internet of Things (IoT) and Big Data, play a crucial role in facilitating and driving the force towards digital technology . A Report by IDC shows that the strategic utilisation of digital technologies significantly enhances an organisation's ability to adapt to change and fosters higher levels of innovation . On the other hand, a study emphasises the complex role of technological advancement that can act as both a driver and a barrier . However, technological advancements such as cloud computing, BigBata, and the Internet of Things (IoT) are critical drivers towards digital technology, offering organisations flexibility, real-time insights, and operational optimisation .

Similarly, big data analytics drives long-term organisational growth by optimizing resource consumption, automating processes, and predicting customer needs making technological advancement an irresistible driver of digital technology. Driving technological advancement to the nigeria manufacturing industry for example; the adoption of digital twin technology in the Nigeria construction industry was based on reliable data storage and safety improvements, as well as customer satisfaction and technology accessibility, which are key motivators driving the adoption of DTT in the Nigerian construction industry.

This technological advancement in the construction industry makes it more efficient to visualise any construction and predict challenges

1.3 Hurdles to digital adoption

In today's rapidly evolving technological environment, digital solutions are no longer a choice but a necessity for businesses and individuals striving to remain competitive and relevant. While the benefits of digital transformation are numerous - ranging from customer satisfaction, and operational efficiencies to expanding market reach - the road to adoption is fraught with many challenges. These challenges stem from structural, cultural, economic and regulatory constraints that slow the rate of integrating digital technologies into Nigerian business.

These barriers, requiring concerted effort from both public and private sectors to overcome, are more pronounced in countries like Nigeria and other developing countries.

Informatics, 291–296. 10.1109/SOLI.2018.8476713
Figueiredo, Ronnie, Soares, Raquel andFerreira, João J.. 2020. Key Strategic Drivers for Business Digital Transformation: Systematic Literature Review. 10.4018/978-1-7998-4552-2.ch006.
Schepinin, V., and Bataev, A. 2019. Digitalization of financial sphere: Challenger banks efficiency estimation. IOP Conference Series. Materials Science and Engineering, 497(1), 012051. Advance online publication. doi:10.1088/1757-899X/497/1/012051

Inadequate infrastructure is one of the most significant barriers to digital adoption. Digital technologies depend heavily on robust physical and digital infrastructure, including reliable internet connectivity, power supply, and computing resources.

In Nigeria, these foundational requirements are most times lacking or inconsistent, significantly affecting the country's business environment. For instance, an e-commerce company in Lagos may face operational challenges due to poor internet connectivity during peak shopping periods, resulting in delayed order processing and customer dissatisfaction. Similarly, a logistics company relying on GPS-enabled tracking faces inefficiencies due to inconsistent power supply or poor network signal. The use of the internet is important in leveraging digital tools. The internet connection in Nigeria has significantly improved in urban areas but still remains limited in rural regions, where over half of the population resides. Many businesses, in particular small and medium enterprises (SMEs), struggle to operate effectively in areas with poor connectivity.

The financial burden of adopting digital technologies is another major hurdle, especially for startups and SMEs with limited resources. Acquiring digital tools like hardware, software, and cloud-based systems can be quite expensive. Even for businesses with the funds, after initial adoption, the ongoing costs of maintaining, updating, and securing digital systems can strain budgets. Many businesses lack access to affordable credit or investment options, making it difficult to fund digital transformation initiatives. A lack of digital literacy and technical experience poses another challenge for businesses wanting to adopt digital technologies. Many businesses, particularly traditional businesses, find it difficult to find employees with the skills to operate and manage these digital systems.

For instance, fields such as data analytics, cybersecurity, and digital marketing require specialized knowledge that is often in short supply. Workers also may resist adopting new technologies due to fear of job displacement or a lack of understanding about the benefits of digital tools. In addition, many organisations do not invest or prioritise employee training, further widening the skills gap. Companies' culture often presents a significant barrier in digital adoption. Scepticism, fear and lack of awareness can stall progress. Due to a lack of trust in technology, the complexities of new systems, and concerns about job security, employees and management may resist change.

Awoniyi Ph.D, Olaolu. (2022). Digital Banking Adoption in Nigeria: The Place of Technology Acceptance Model. Asian Journal of Economics Business and Accounting. 22. 59-72. 10.9734/ajeba/2022/v22i730579.
Alexopoulos, A., Becerra, Y., Boehm, O., Bravos, G., Chatzigiannakis, V., Cugnasco, C., Demetriou, G., Eleftheriou, I., Fotis, S., Genchi, G., Ioannidis, S., Jakovetic, D., Kallipolitis, L., Katusic, V., Kavakli, E., Kopanaki, D., Leventis, C., Martínez, M., Mascolo, J., … Vinov, M. (2022). Big Data Analytics in the Manufacturing Sector: Guidelines and Lessons Learned Through the Centro Ricerche FIAT (CRF) Case. In E. Curry, S. Auer, A. J. Berre, A. Metzger, M. S. Perez, & S. Zillner (Eds.), Technologies and Applications for Big Data Value pp. 321–344. Springer International Publishing. https://doi.org/10.1007/978-3-030-78307-5_15 IDC. (2018). Transforming Enterprise Work Execution. https://www.smartsheet.com/sites/default/files/FINAL_Smartsheet%20InfoBrief.pdf Tsiavos, V., & Kitsios, F. (2022). Technology as Driver, Enabler and Barrier of Digital Transformation: A Review (pp. 681–693). https://doi.org/10.1007/978-3-030-95947-0_48 David Alvaro & Cynthia A. Challener. (2022, October 11). Leveraging Big Data, Artificial Intelligence, and Machine Learning for Drug Discovery, Development, Manufacturing, and More.
Alexopoulos, A., Becerra, Y., Boehm, O., Bravos, G., Chatzigiannakis, V., Cugnasco, C., Demetriou, G., Eleftheriou, I., Fotis, S., Genchi, G., Ioannidis, S., Jakovetic, D., Kallipolitis, L., Katusic,V., Kavakli, E., Kopanaki, D., Leventis, C., Martínez, M., Mascolo, J., … Vinov, M. (2022). Big Data Analytics in the Manufacturing Sector: Guidelines and Lessons Learned Through the Centro Ricerche FIAT (CRF) Case. In E. Curry, S. Auer, A. J. Berre, A. Metzger, M. S.Perez, & S. Zillner (Eds.), Technologies and Applications for Big Data Value (pp. 321–344).
Springer International Publishing. https://doi.org/10.1007/978-3-030-78307-5_15

Established companies, especially those with a history of success, may be reluctant to adopt new digital tools. All these are a result of not wanting to disrupt traditional processes and adopting new methods. With increased reliance on digital technologies comes heightened exposure to cybersecurity threats such as data breaches, ransomware, and phishing attacks.

Many businesses underestimate the importance of cybersecurity and fail to implement adequate protective measures. A single cybersecurity incident can damage a company's reputation and erode customer trust, deterring further digital adoption.

In Nigeria, inconsistent or unclear policies often create uncertainty, deterring investment in digital transformation. Policy gaps, such as conflicting regulations regarding technology imports, intellectual property, and data usage, further contribute to confusion for businesses. Additionally, bureaucratic delays, including lengthy approval processes for accessing government-backed digital programs, exacerbate the situation and discourage adoption efforts. Economic instability, inflations, and market fluctuations further complicate digital adoption. In developing economies like Nigeria, the cost of digital solutions is often out of reach for many businesses and consumers.

The readiness of customers to embrace digital platforms also affects adoption rates. Many consumers, especially older demographics, prefer traditional methods over digital platforms.The hurdles to digital adoption are diverse and multifaceted, requiring coordinated efforts, from governments, businesses, and other stakeholders to address.

In countries like Nigeria, where infrastructure deficits, economic challenges, and skills gaps are pronounced, overcoming these barriers will significantly unlock opportunities for economic growth and social progress.

By investing in infrastructure, providing affordable digital solutions, fostering a culture of innovation, and prioritising cybersecurity, organisations can accelerate digital transformation and position themselves for success in the global digital economy.

Victor Adetunji Arowoiya, Ayodeji Emmanuel Oke, Lekan Damilola Ojo, and Ayomide Oluwafemi, 2023. Driving Factors for the Adoption of Digital Twin Technology Implementation for Construction Project Performance in Nigeria, Journal of Construction Engineering and Management. 150(1). https://doi.org/10.1061/JCEMD4.COENG-13659

Jurnal Mekanikal, 2024." ."The impact of digital transformation on nigerian small and medium-sized enterprises (smes) in the global business landscape. Available at:https://jurnalmekanikal.utm.my

World Bank, 2022. Digital Economy for Africa: Opportunities and Challenges. [Online] Available at: https://www.worldbank.org

Statista, 2023. Internet Penetration in Nigeria. [Online] Available at: https://www.statista.com

International entities also advocate for regulatory frameworks that promote digital adoption in Nigeria. The United Nations (UN) and the African Union (AU) placed emphasis on the need for digital inclusivity and robust data protection. A game-changer in Nigeria, is the African Continental Free Trade Area (ACFTA) agreement, encouraging many businesses to adopt digital solutions to compete effectively in the regional market. AfCFTA compels Nigerian businesses to integrate technology into their operations, by fostering e-commerce and cross-border trade.Additionally, Nigeria's Collaboration with foreign governments has increased the rate of technological advancements.

Partnerships with countries like the United States of America, the United Kingdom, and China have led to knowledge sharing, joint ventures, and technology transfer. For example, China has been instrumental in funding Nigeria's broadband expansion projects, while the UK's Africa Technology and Innovation Partnership (ATIP) supports Nigerian startups.The Nigerian government has also been very proactive in setting the stage for digital transformation.

The National Digital Economy Policy and Strategy (2020–2030) is a comprehensive roadmap aimed at positioning Nigeria as a global leader in the digital economy. The strategy focuses on critical areas such as digital literacy, financial inclusion, cybersecurity, and broadband penetration. Under this policy, the government has encouraged private-sector investment in technology and created opportunities for businesses to adopt digital tools. Another noteworthy policy is the Nigeria Startup Act, which provides a regulatory framework to support the growth of startups. By offering tax incentives, funding opportunities, and legal protections, this act has created an enabling environment for tech entrepreneurs. The establishment of the Technology Innovation and Entrepreneurship Support Scheme is another testament to the government's commitment to fostering innovation.

Infrastructural development is central to the government's digital transformation agenda. Public-private partnerships have been instrumental in advancing digital infrastructure. Collaborations between the government and telecom companies like MTN and Airtel have led to the rollout of 4G and 5G networks, providing faster and more reliable internet services. These advancements enable businesses to adopt digital solutions such as cloud computing, big data analytics, and e-commerce platforms.

International Finance Corporation, 2023. Digital Adoption and SMEs. [Online] Available at: https://www.ifc.org Accessed 28 Nov 2024
OECD, 2022. Digital Skills and the Future of Work. [Online] Available at: https://www.oecd.org
Kaspersky, 2023. State of Cybersecurity in 2023. [Online] Available at: https://www.kaspersky.com

1.4 International and government influence on digital transformation

Digital transformation has emerged as a pivotal driver of economic growth, innovation, and competitive advantage for businesses worldwide. In Nigeria, this transformation is shaped by both international organisations and governments playing crucial roles in its process. International organizations, foreign governments, and multinational corporations contribute through funding, training, and policy advocacy, while the Nigerian government implements strategies, regulations, and infrastructure projects to support this transition. These bodies influence the adoption and implementation of digital technologies through funding, policy-making, partnerships, and infrastructure developments.

However, the journey toward comprehensive digital transformation in Nigeria is fraught with challenges, requiring collaborative efforts to address systemic barriers and optimize the potential of digital technologies.International organisations such as the World Bank, the International Monetary Fund (IMF), and regional development banks, have long been involved in facilitating Nigeria's economic growth, including efforts toward digital transformation. These institutions provide financial support to projects aimed at enhancing Nigeria's digital infrastructure. These institutions provide financial assistance for digital transformation projects.

For example, the World Bank's Digital Economic for Africa (DE4A) initiative supports developing countries like Nigeria in improving their digital infrastructure. These investments often translate into improved broadband infrastructure, digital literacy programs, and access to digital tools for small and medium enterprises (SMEs).

Global tech giants such as Microsoft, Google, and Facebook also play a vital role in shaping the digital landscape in Nigeria. Microsoft, through its Africa Development Center, collaborates with Nigerian developers and businesses to foster innovation in artificial intelligence (AI), cloud computing, and software development.

In Nigeria, Google's Digital Skills for Africa program has trained over one million individuals in digital skills, contributing to a more technology-savvy workforce. Similarly, Facebook has established innovation hubs in Nigeria, providing a platform for startups to thrive.

International Finance Corporation, 2023. Digital Adoption and SMEs. [Online] Available at: https://www.ifc.org

The National Broadband Plan (2020 - 2030), an initiative by the government, aims to achieve 70% broadband penetration by 2025, thereby enhancing internet access across the country.

This initiative has improved the issues of connectivity for businesses, especially those in remote areas. To further strengthen the digital ecosystem, the government has also partnered with private organisations to develop fibre optic networks and data centres.

With investment in capacity-building programs by the Nigerian government, initiatives like the Digital Skills Nigeria Program, implemented in partnership with Microsoft, are dedicated to training millions of Nigerians in areas such as coding, cybersecurity, and data science.

These programs not only enhance employability but also equip businesses with the talent needed to dr

World Bank, 2022. Digital Economy for Africa: Opportunities and Challenges. [Online] Available at: https://www.worldbank.org
World Bank. (2021). The World Bank digital economic diagnostic for Nigeria. Retrieved from https://www.worldbank.org d
Microsoft, (2023). Africa Development Center: Transforming the African tech landscape. Retrieved from https://microsoft.com
Goggle, 2023. Digital Skills for Africa: Impact Report. [Online] Available at: https://www.goggle.com/africa/digital-skills
African Union. (2020). African Continental Free Trade Area (AfCFTA) and its Implications for digital trade. Retrieved from https://www.au.int

PART TWO

Part Two: Milestones of Digitalisation Across Nigerian Business Sectors

ROME BUSINESS SCHOOL

2.1 The success stories of Nigerian business sectors

The success story of Nigerian businesses and how they have been able to harness digital tools to optimise business processes such as manufacturing, packaging, marketing and distribution, customer satisfaction and product evaluation hinges on the ability of each of these businesses to use technological tools. In manufacturing, 3D printing with the help of its computer-aided designs has made it possible for prototypes of specific products to be made and tested to determine their durability and customer satisfaction level before it is actually made. It is used in modelling and making lightweight parts.

The automotive industry, for instance, records that the 2024 Cadillac Celestiq is said to have over a hundred 3D-printed parts. However, the use of 3D in the manufacturing sector in Nigeria is still at its budding or nascent stage with the potential for immense impact. Consequently, Russelsmith, in Nigeria is leading the adoption of additive manufacturing in Nigeria and West Africa, and in April 2024, recorded the successful use of 3D printing to manufacture an air release valve for a water piping system, operating at a pressure of 10 bar (approximately 145 psi) at sea level, using its Roboze Argo 500 industrial 3D printer, in line with the Fused Filament Fabrication (FFF) technique.

Also, in 2023 Russelsmith became the first 3D industrial manufacturing corporation to manufacture anti-corrosion components for the Nigerian Upstream Petroleum Regulatory Commission (NUPRC). This signifies a shift from the use of traditional and corrosion-prone components to more sustainable and digitised CAD models which had hitherto been unused.

Another success story in Nigeria is in the banking industry. Banking is an age old practice that has evolved for years to reflect the technologies of every society that administers it.

In Nigeria, banking has transitioned from the barter system to the use of cowries and, eventually to analogue methods such as the use of bank tellers, manually updating ledgers, and queuing for cash withdrawals and deposits at banks.

The advent of technology revolutionised the narrative of the system in general. In Nigeria, like in every part of the globe, the business of banking advanced to incorporate basic data analysis and spreadsheet software such as MS Excel and other software for accounting purposes.

Federal Ministry of Communications and Digital Economy. (2020). National Digital Economy Policy and Strategy (2020 - 2030). Available at:https://www.ncc.gov.ng

Federal Ministry of Communications and Digital Economy. (2020). National Digital Economy Policy and Strategy (2020 - 2030). Available at:https://www.ncc.gov.ng

Federal Ministry of Communications and Digital Economy. (2020). National Digital Economy Policy and Strategy (2020 - 2030). Available at:https://www.ncc.gov.ng

At present, mobile transactions and internet banking characterise the least of Nigeria's banking operations, and these are made possible by means of internet connectivity and digital technologies like AI and machine learning algorithms like Zenith Bank's AI virtual assistant that runs its mobile customer service.

Automated Teller Machines (ATMS) are also positive turning points in Nigerian banking. They are based on computer protocols like ISO 8583 and other computer languages. Since its inception in 2011 following the Central Bank of Nigeria's Cashless Policy 2011, its number has moved from 10,000 to 22,500 in 2022 with its transaction value increasing from 1.98 trillion in 2022 to 12 trillion naira in 2020.

Similarly, financial technology (Fintech), which involves the use of new technological advancements to products and services in the financial industry, is the tentative benchmark for modern banking today. As such, in Nigeria, investment in technological tools is said to be influenced either by the cashless policy of the Central Bank of Nigeria or by the personal interest of these banks. According to Jaiyeola as cited by Usoro, the financial reports of commercial banks in Nigeria for the first half of 2022 noted that ten (10) commercial banks spent N81.92 billion on ICT services, a 58.7 % increase from the N51.62 billion spent by the banks in 2021.

This indicates that commercial financial institutions in Nigeria are really pouring their capital into ICT tools to augment their services which would engender greater financial returns. For instance, Aina notes in a report that banks have been able to grow digital channel transactions to N600 trillion, and this increase in revenue is seen by Afrinvest Research to be a product of factors like an increase in the usage of digital financial channels which has an equally engendered effective optimization of interest rates for trading and better loan pricing.

Therefore, it is clear that digitising the banking industry in spite of relative challenges has brought tremendous profit and gains into the economy and changed the narrative occasioned by traditional banking through the automation of processes, for instance, the use of decentralised ledgers (DLT) for tracking and monitoring as well as ensuring accountability in transactions and peer-to-peer borrowing from investors, blockchain and AI for risk assessment and 24/7 customer service.

Anon. 2024a. *Additive Manufacturing Market Size Report, 2030*. [online] Available at: <https://www.grandviewresearch.com/industry-analysis/additive-manufacturing-market> [Accessed 29 November 2024].

Murray, C., 2023. Common Applications Of 3D Printing: From Aerospace To Fashion. *Forbes*. [online] 21 Apr. Available at: <https://www.forbes.com/sites/conormurray/2023/04/21/common-applications-of-3d-printing-from-aerospace-to-fashion/> [Accessed 29 November 2024].

Case Studies – RusselSmith. [online] Available at: <https://russelsmithgroup.com/case-studies/> [Accessed 29 November 2024].

In addition, the health sector in Nigeria has equally benefited from the knowledge derived from digitisation. From diagnosis to treatment, the health sector deploys the technological tools for better care services to patients.

Today, the Nigerian health sector in spite of the challenge of lack of widespread digital literacy and connectivity in some rural communities has been to digitise the process of consultation and patient monitoring by capitalising on the Internet of Things (IoT). IoT is a network of physical devices, vehicles, appliances, and other physical objects also known as 'smart objects' that are embedded with sensors, software, and network connectivity, allowing them to collect and share data. Previously, patients could only get medical attention by physically visiting hospitals to be diagnosed and treated but today the narrative has broadened to allow them the opportunity of choice.

With internet connectivity, mobile phones and other smart devices, consultations can now be made from anywhere in the country through the use of NigComHealth. Inaugurated on May 15, 2023, through the partner of NIGCOMSAT (Nigeria's communication satellite company), Ethnomet and Sawtrax, NigComHealth became the first telemedicine network in Nigeria with provisions to integrate all hospitals in the nation and allow healthcare professionals to provide medical attention to Nigerians, particularly the 1.7 million individual employed in the public sector.

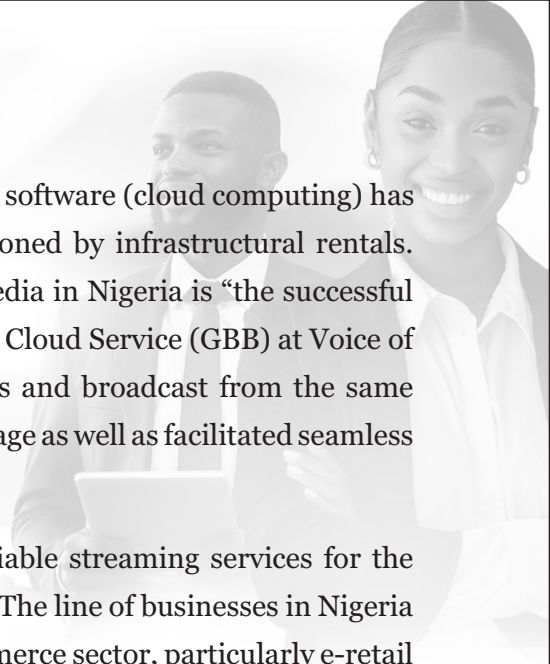
NIGCOMHEALTH is a telehealth service that enables Nigerians to book appointments, receive medical advice, and consult with physicians and healthcare practitioners from the comfort of their homes, offices, schools, and localities. Its main aim is to mitigate the burden of physical hospital visits and expedite quality medical attention. With over 33 million active social media users and about 154 million internet in Nigeria users, smart devices are deployed to ensure quicker healthcare services as against traditional hospital visits and physical consultations. Furthermore, the broadcast media has drawn a lot of gains from the use of digital tools since the advent of ICT. ICT has empowered the broadcast media to transcend traditional conventions which were limiting because information was asynchronous, in the sense that only newscasters and reporters were allowed the structural prerogative to communicate.

However, the advent of new technologies in hardware (smart TVs) and software (cloud computing) has made broadcasting less expensive due to upfront investments occasioned by infrastructural rentals.

Anon. 2024d. *Role of ATMs, PoS in Cashless Policy – THISDAYLIVE*. [online] Available at: <https://www.thisdaylive.com/index.php/2023/01/26/role-of-atms-pos-in-cashless-policy/> [Accessed 29 November 2024].

Research, https://www. alliedmarketresearch. com/ A.M., 2024. *Fintech Technologies Market Size, Share, Competitive Landscape and Trend Analysis Report, by Deployment Mode, Application, Technology and End User : Global Opportunity Analysis and Industry Forecast, 2021-2030*. [online] Allied Market Research. Available at: <https://www.alliedmarketresearch.com/fintech-technologies-market> [Accessed 28 November 2024].

Usoro, U., 2022. *Impact of Technology on Financial Services*. pp.79–96. [online] Available at: https://dc.cbn.gov.ng/efr/vol60/iss4/8/



However, the advent of new technologies in hardware (smart TVs) and software (cloud computing) has made broadcasting less expensive due to upfront investments occasioned by infrastructural rentals. Cogent instances where cloud computing has helped the broadcast media in Nigeria is "the successful implementation of Amazon Web Services (AWS) and Galaxy Backbone Cloud Service (GBB) at Voice of Nigeria (VON)" to store and edit audio-visual information resources and broadcast from the same central storage platform. This has ensured a reduction in the cost of storage as well as facilitated seamless broadcast beyond the boundaries of time and location.

The availability of the internet has also fostered faster and more reliable streaming services for the broadcast media in modern times, in Nigeria and the world as a whole. The line of businesses in Nigeria that have gained from digitising their business procedures is the e-commerce sector, particularly e-retail or e-merchandise businesses like Jumia, Konga and Jiji. For instance, Jumia is a leading e-commerce platform in Africa with branches all over Nigeria that has taken shopping to another level by administering sales of varieties of goods and services on the Internet. Through the use of blockchain technology and virtual reality, assets and customer experiences on this platform are managed to reflect a transparent, secure and seamless response and feedback system which contrasts the conventions of physical and traditional markets and stores.

As an online retailing enterprise, Jumia As a result of the advantage of digital technology, the company witnessed a 6 per cent increase in the number of orders, reflecting continued user interest and engagement. Through blockchain technology, Jumia successfully integrated a reliable payment system into its e-commerce branches and has anchored on IOT to converge and streamline its B2B and B2C business outlook by making it possible for SMEs to connect with clients as vendors via the Jumia platform, while consumers are offered ample opportunities to choose from a large pool of goods or products of their choice.

To corroborate this, Pantami remarks that, "e-commerce is supporting many businesses in Nigeria, the majority of whom are MSME enterprises and are not income earners. Without e-commerce, it is difficult for them to do their businesses effectively because the profit they generate on their own without e-commerce is generally not a huge amount of money.

Aina, T., 2024. *Banks grow digital channels transactions to N600tn—Report*. [online] Punch Newspapers. Available at: <https://punchng.com/banks-grow-digital-channels-transactions-to-n600tn-report/> [Accessed 28 November 2024].
Ibid (n-27)
IBM, n.d. Internet of Things. *IBM*. Available at: <https://www.ibm.com/topics/internet-of-things> [Accessed 29 November 2024].
Isaac, N., 2023. *1.7Million Nigerians To Benefit From Launch Of NIGCOMHEALTH Virtual Hospital*. [online] Science Nigeria. Available at: <https://sciencenigeria.com/1-7million-nigerians-to-benefit-from-launch-of-nigcomhealth-virtual-hospital/> [Accessed 29 November 2024].

E-commerce provides a certain form of support so that their businesses can be very successful." As an e-commerce platform, Jumia also integrates data analytics to make predictions about products based on customers' data or purchase history. The transport sector is another niche in the Nigerian business world that has been greatly impacted by digital advancement. Land transportation in Lagos state is evolving to accommodate a more digital and safer mode of commuting through the introduction of Cowry cards in 2020 for Bus Rapid Transit (BRT). Prior to the introduction of Cowry cards for BRTs, the story of commuting via BRTs which came into existence in the 2000s was akin to that of Danfo buses, the yellow or gilded buses of varying sizes, that are primarily used for transportation in Lagos. However, with the introduction of the Cowry card that operates by means of embedded integrated circuit , transportation in Lagos by BRT, ferry and train has experienced better revenue returns, ensured optimal customer satisfaction as well as aided government index in terms of population analysis in order to make better transport policies, as noted by Abimbola Akinajo. Between August and September 2023, the Lagos state government recorded that 7.4 million passengers patronised BRTs, 17,543 commuted via ferries, and this resulted in about 2 billion naira.

2.2 Integrating Technology: ICT, AI, IoT, Cloud, and Cybersecurity

Technology has taken over every business activity with the integration of digital tools like AI, IoT, and cloud. Businesses and different sectors employ technology integration as an approach to choosing and refining their products, services, and processes. This has led to improved efficiency and overall performance in these sectors. The increase in technological improvement and digital acceptance warrants the need for banks to integrate advanced technological means to provide improved financial services. The use of cash for daily transactions transitioned into electronic payment methods. The use of point-of-sale (POS) terminals and smart card readers for processing transactions has increased the rate and speed of fund distribution. The value of bank transactions using point of sale (POS) systems and automated teller machines (ATMs) increased from 144.76 billion and 1,069.99 billion to 633.81 billion and 1,539.26 billion respectively depicting the positive acceptance and adoption of technological innovations .

Due to the continuous technological advancement in the country leading to increased cyber threats, businesses within the financial sector continually seek solutions to enhance security and mitigate risk.

Yusuf, N., Muogbo, C., and Bolajoko, K., 2022. Digital Healthcare trend in Nigeria copy. *Verraki Business Solutions for Africa*, pp.1–17. https://verraki.africa/wp-content/uploads/2022/12/Digital-Healthcare-Report_Verraki-Africa_-final-copy-for-publishing_Dec-2022-1.pdf [Accessed 29 November 2024].

Anon. 2024c. *Reports*. [online] National Bureau of Statistics. Available at: <https://nigerianstat.gov.ng/elibrary/read/1241133> [Accessed 29 November 2024].

Online, T., 2024. *Cloud technology and Nigeria's broadcast media.* [online] Tribune Online. Available at: <https://tribuneonlineng.com/cloud-technology-and-nigerias-broadcast-media/> [Accessed 29 November 2024].

Ibid (n-65)

One of the solutions lies in the integration of artificial intelligence with blockchain technology. Artificial intelligence (AI) integration with blockchain technology forms a transformative approach used to enhance security in financial services. The blend of these digital tools can help organisations within this sector to develop solutions that address diverse security challenges and streamline processes , .

The synergy between these digital tools lies in AI's analytical capabilities which are enhanced by the secure and transparent platform blockchain offers. Employing this in business systems ensures optimal security and transparency within the entire financial ecosystem.Also, the use of ICT in the Nigerian healthcare sector has transformed the sector beyond what it used to be. One of the most common causes of death in the country is cardiovascular diseases, coupled with the lack of healthcare with an average of 17 hospitals to 100,000 people. This coupled with the nation's population drove the need for integrating artificial intelligence into the healthcare system.

The Lagos University Teaching Hospital designed a manufactured an AI-powered system to facilitate early breast cancer diagnosis using machine learning (ML) algorithms .The use of remote monitoring systems allows patients to track their health conditions, avoiding frequently visiting the hospital. This has helped patients suffering from diabetes, for instance, to monitor their blood sugar from home and eat an adequate diet .

A Nigerian start-up, Wellvis, built an AI-powered telemedicine platform that allows patients to remotely consult with healthcare providers. Other healthcare providers integrating AI and cloud solutions for clinical decision-making include Xolani Health, using DICOM-X, a system to software to support image diagnosis and analysis as well as ARONE, an app-based ordering system for procuring medicines online. 10mg, an AI-powered logistic management system, is used by Pronov to match medical providers with finance partners enabling bulk medication purchases .

The integration of AI into the healthcare system has led to transformative changes within the sector such as the ability to better understand disease and its root cause, leading to improved healthcare delivery and outcomes79, . In the agricultural sector, the concept of industry 4.0 — which incorporates several technologies including system integration, big data analytics, cloud computing, internet of things (IoT), artificial intelligence/machine learning, and cyber-physical systems – is integrated to achieve maximum output.

Anon. 2021. *Currency pressure drives Jumia's revenue to $36.5mn in Q3'24 (CNBC Africa)*. [online] Jumia Group. Available at: <https://group.jumia.com/news/currency-pressure-drives-jumia-s-revenue-to-36-5-mn-inq3-24> [Accessed 29 November 2024].

Anon. 2021b. *Digital Economy Minister of Nigeria commends Jumia operations on its 9th anniversary*. [online] Jumia Group. Available at: <https://group.jumia.com/news/digital-economy-minister-of-nigeria-commends-jumia-operations-on-its-9th-anniversary?location=nigeria> [Accessed 29 November 2024].

Anon. 2024b. *eCommerce app development services*. [online] Appinventiv. Available at: <https://appinventiv.com/ecommerce-app-development/> [Accessed 29 November 2024].

Anon. 2024f. *what technologies are smart cards made of?* [online] Google Search. Available at: <https://www.google.com/search?q=what+technologies+are+smart+cards+made+of%3F&oq=what+technologies+are+smart+cards+made+of%3F&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigATIHCAMQIRigATIHCAQQIRifBTIHCAUQIRifBdIBCTE3MjQ0ajBqN6gCALACAA&sourceid=chrome&ie=UTF-8> [Accessed 29 November 2024].

Olaoluwa, J., 2024. YC-Backed Touch and Pay processes 500,000 daily payments with Cowry cards in Lagos. *TechCabal*. [online] 5 Mar. Available at: <https://techcabal.com/2024/03/05/cowry-card-payments-tap-and-go-technology/> [Accessed 29 November 2024].

This offers a holistic approach entailing the digitalisation of all agricultural processes . IoT and AI applications are used in farm monitoring with robot-enabled AI used to monitor respiration, photosynthetic activity, and yield. It is also employed in pollution monitoring, measuring carbon dioxide and nitrous oxide emissions, intelligent farm chemicals application, and plant disease and insect detection .

Tools like Motive and CropX are used to detect pests and diseases early, minimising waste and enhancing sustainability. GPS trackers, such as Herddogg, and drones are used by herders to monitor their animals and prevent losses. Wearable sensors are used to monitor animals' pulse rate and temperature . Nigeria is a country that relies on oil for economic survival. However, there are complexities within the industry impacting the supply networks. Oil spills have extensively infiltrated ecosystems, food chains and water bodies. This has not only led to environmental degradation but also a loss in the country's revenue .

Oil theft is one of the most common challenges affecting the industry and leading to economic losses. However, the integration of IoT found relevance in combating this challenge with the application of digital tools that detect and prevent vandalism and oil spillage. Multi-agent Systems (MAS), a collection of multiple intelligent systems, are used to detect abnormal pressure from the environment, which sends a signal to a mobile agent .

The use of IoT through wireless sensor networks has also found significance in combating this challenge. In cases of vandalism from trucks, a real-time alarm is received at an intelligent terminal if the quantity of crude oil changes suspiciously.

Machine learning is also utilised for detecting oil spills through remote sensors using optical and microwave methods for capturing data .

2.3 Leading regions: Digital hubs for businesses in Nigeria

With a population of over 200 million people and the fourth-largest economy in Africa, Nigeria is positioned as a hotbed for innovation and technological advancement. Accounting for about 29% of internet usage in Africa, Nigeria is the largest ICT market in Africa . As such, the technology landscape is a myriad of thriving tech development and innovation centres contributing to the rapidly growing industry.

Kama, K.C., Obiora Emeka Ikedilo and Alisigwe, J.N. (2022). ICT Enhancement in Deposit Money Banks: A Requisite for Economic Development in Nigeria. International Journal of Technology Management, [online] 11(7), pp.45–56. Available at: https://www.researchgate.net/publication/359879117_ICT_Enhancement_in_Deposit_Money_Banks_A_Requisite_for_Economic_Development_in_Nigeria.

This digital economy is largely determined by several important digital hubs existing across various locations in the country, with each area having its own fundamental strengths and specialisations. In a way to foster the digital economy, several efforts have been made by the federal government, individuals, corporate organisations and the government at various tiers.

The federal government made plans in 2023 to launch digital hubs in 7 states across the country .

The Nigeria Information Technology Development Agency (NITDA) also embarked on a number of initiatives to promote innovation and technology entrepreneurship. This growing initiative, coupled with the increase in internet penetration rate of over 55%, Nigeria's capital, Lagos, serves as the digital hotspot with an ecosystem of startups, tech companies and investors. For international suppliers and manufacturers looking to invest in Nigeria's expansive market potential, it is necessary to garner knowledge of these innovation centres.

This paper offers a comprehensive guide to the leading regions in Nigeria, providing valuable insights into their major industries as well as the available opportunities. Furthermore, it is important to state that the selection of these regions was based on certain criteria. These measures include the availability of a high percentage of skilled workforce, the presence of educational facilities that provide quality digital education, the economic contribution of each listed area to the gross domestic product of the country, and proximity to international markets; which ensures easy distribution and accessibility to consumers and the availability of major infrastructure such as good roads, ports, steady power supply and efficient communication networks .

1. South West: Lagos state, also known as the powerhouse, this region stands as the pillar of Nigeria's industrial hub. A wide encompassment stretching from the thriving metropolis of Lagos and into the neighbouring Ogun State. This region is the primary ecosystem of Nigeria's manufacturing sector, contributing over 50% of the country's industrial and digital output. With Lagos state being the first, followed by Oyo State, the southwest region of Nigeria houses the highest number of innovation hubs in the country. This includes Co-Creating Hub (CcHUB), also dubbed as Nigerian Silicon Valley, is an open lab and pre-incubation space serving as a multifunctional and multi-purpose space. Other hubs in the southwest region include Wennovation Hub, West Africa .

Olubusola Odeyemi, Chinwe Chinazo Okoye, Onyeka Chrisanctus Ofodile, Omotayo Bukola Adeoye, Wilhelmina Afua Addy and Adeola Olusola Ajayi-Nifise (2024). Integrating ai with blockchain for enhanced financial services security. Finance & Accounting Research Journal, 6(3), pp.271–287. doi:https://doi.org/10.51594/farj.v6i3.855.
Effiong Benjamin, U., Samuel, I. and Isaac, M. (2024). Implementation and Integration of Artificial Intelligence for Financial Process Innovation of Commercial Banks in Nigeria. Indonesian Annual Conference Series, 3, p.2024.
Ayedun , O. (2024). Analysis of Smart Service Usage in the Healthcare Sector in Nigeria . [online] Muni.cz. Available at: https://is.muni.cz/th/posac/Oluwatoyosi_Mercy_Ayedun_Archive.pdf [Accessed 29 Nov. 2024].
Salman Aonat (n.d.). The role of technology in nigeria's healthcare – Slum and Rural Health Initiative. [online] SRHIN. Available at: https://srhin.org/the-role-of-technology-in-nigerias-healthcare/.

The success of this region is built on a foundation of structured advantages, including proximity to one of Nigeria's busiest seaports, a wide consumer market which details over 20 million people in the Lagos metropolitan area, and more relatively, well-organised digital skill training, funded by the Lagos State Employment Trust Fund to provide courses such as digital marketing, coding and other digital innovation courses.

In Lagos, the thriving industrial activities are concentrated in areas such as Yaba, Victoria Island (Co-Creating Hub), Ilupeju, Ikeja and Apapa. These locations host a vast range of companies, from food and beverages to electronics, chemicals, and textiles . The Lagos-Ogun axis is particularly attractive to the majority of Nigerian startups and major corporations. The high concentration of networking activities creates a constant demand for a skilled workforce and digital evolution. Lagos hosts one of the country's top tech incubation centres and has been a long-term host to leading fintech companies like Paystack . Akure is also referred to as the emerging tech hub of Nigeria.

The transformation of this city is largely driven by the combination of private sector investments, state government initiatives and the Federal University of Technology, Akure (FUTA). The Akure Tech Hub, an initiative of the government, was created to foster the growing ecosystem of tech startups and digital service providers that were being established in the area . This initiative is complemented by the Ondo-Linyi Industrial Hub, a planned focus on the agro-allied industries .

Akure provides opportunities in generating economic inputs, control of food processing equipment, and technology-related activities. The developing tech sector is creating an increase in demand for computer hardware, and other IT-related equipment. However, like other areas, Akure faces challenges in its digital development.

The inconsistency of power supply poses a barrier to the speedy growth of digitalization in the area. Businesses operating in this location often require the need to be self-sufficient in terms of power supply. Despite these challenges, The potential of Akure as a digital hub cannot be undermined. The combination of a technology focus on the agro-industrial base upholds the city in a position well for digital growth, particularly in high-value agricultural processes and general operations .

Sochima Johnmark Obiekwe, Ikechukwu Benjamin Omaga, Mmesoma Miriam Ukadike, Chidera Gabriel Edeh, Chinyere Esther Iheanyi, Promise Ugochuku Anisiobi, Obi, C.F., Ogenyi, S. and Obi, E. (2024). The Integration of Artificial Intelligence in Healthcare: A Cross-Sectional Study on the Knowledge, Perception, and Readiness of Medical Students at a Tertiary Institution in Nigeria. Apollo Medicine. doi:https://doi.org/10.1177/09760016241287301.

Rotimi Rufus Dinrifo, Akindele, F., Audu, J. and Adeyemi Adegbenjo (2022). A review of the applications of artificial intelligence in agriculture: prospects and challenges in Nigeria. ResearchGate, [online] 27(2), pp.1–23. Available at: https://www.researchgate.net/publication/370683604_A_REVIEW_OF_THE_APPLICATIONS_OF_ARTIFICIAL_INTELLIGENCE_IN_AGRICULTURE_PROSPECTS_AND_CHALLENGES_IN_NIGERIA.

AgroNigeria (2024). Agritech: IoT Application in Agriculture. [online] AgroNigeria - AgroNigeria. Available at: https://agronigeria.ng/agritech-iot-application-in-agriculture/ [Accessed 29 Nov. 2024].

Bello, S., Dikko, M. and Rawayau, A. (2024). View of Internet of things-based wireless sensor network system for early detection and prevention of vandalism/leakage on pipeline installations in the oil and gas industry in Nigeria. [online] Fudutsinma.edu.ng. Available at: https://fjs.fudutsinma.edu.ng/index.php/fjs/article/view/1927/1588 [Accessed 29 Nov. 2024].

2. North Central: Locations like Abuja and Plateau are home to the highest number of hubs in this region such as Enspire Incubator, and nHub Nigeria .

As the capital of Plateau State, Jos offers a valuable premise as an industrial hub. In the past years, the inhabitants of Jos have been working greatly towards the diversification of its digital base.

The Jos industrial layout accommodates a vast range of industries, which includes food processing, beverages, and mineral processing. The city's history of tin mining has also left it with a legacy of metalworking skills that continue to be relevant in various manufacturing sectors.

However, it has become a need for businesses carrying out their operations in Jos to navigate digital challenges such as the control and maintenance of metal manufacturing machinery.

This has resulted in a high demand for skilled workers who possess the expertise required for the major evolution. Surprisingly, the city has become a thriving hub of tech skills acquisition and a focal point for digital innovation and growth in Nigeria. As the enclave of tech skill and digital innovation, the ecosystem gives it a push to reach its potential as a global tech hub .

The growth of urbanisation in Abuja, which has been estimated to be 8.32 % per annum has paved the way for it to be listed amongst the top digital regions in Nigeria. The major driver of this growth is the economic opportunities the area presents to the businesses that have been established to exploit the present technology offers and the potential innovations that are bound to arise.

There are also a good number of tech hubs existing in the environment, such as Abuja Technology Village Science and Technology Park, the Civic Innovation Lab, and Clean Technology Hub, amongst others that were established to foster the research, implementation and commercialisation of technology in Nigeria .

3. South East: Anambra state has witnessed technological innovations with the establishment of several hubs, such as. Awka Innovation Hub and Nnewi Tech Hub, emerging when compared to Enugu which serves as home to most digital hubs in the region such as Roar Nigeria Tech Hub and Enugu Tech Hub. Onitsha, recognized as one of the biggest commercial centres in West Africa, was not initially referred to as a digital hub.

Adelowo, E. and Oladele, F. (2022). Application of Artificial Intelligence and Internet of Things in Curbing Oil Theft in Nigeria Application of Artificial Intelligence and Internet of Things in Curbing Oil Theft in Nigeria. doi:https://doi.org/10.13140/RG.2.2.26648.88329.

Adelowo, E. and Oladele, F. (2022). Application of Artificial Intelligence and Internet of Things in Curbing Oil Theft in Nigeria Application of Artificial Intelligence and Internet of Things in Curbing Oil Theft in Nigeria. doi:https://doi.org/10.13140/RG.2.2.26648.88329.

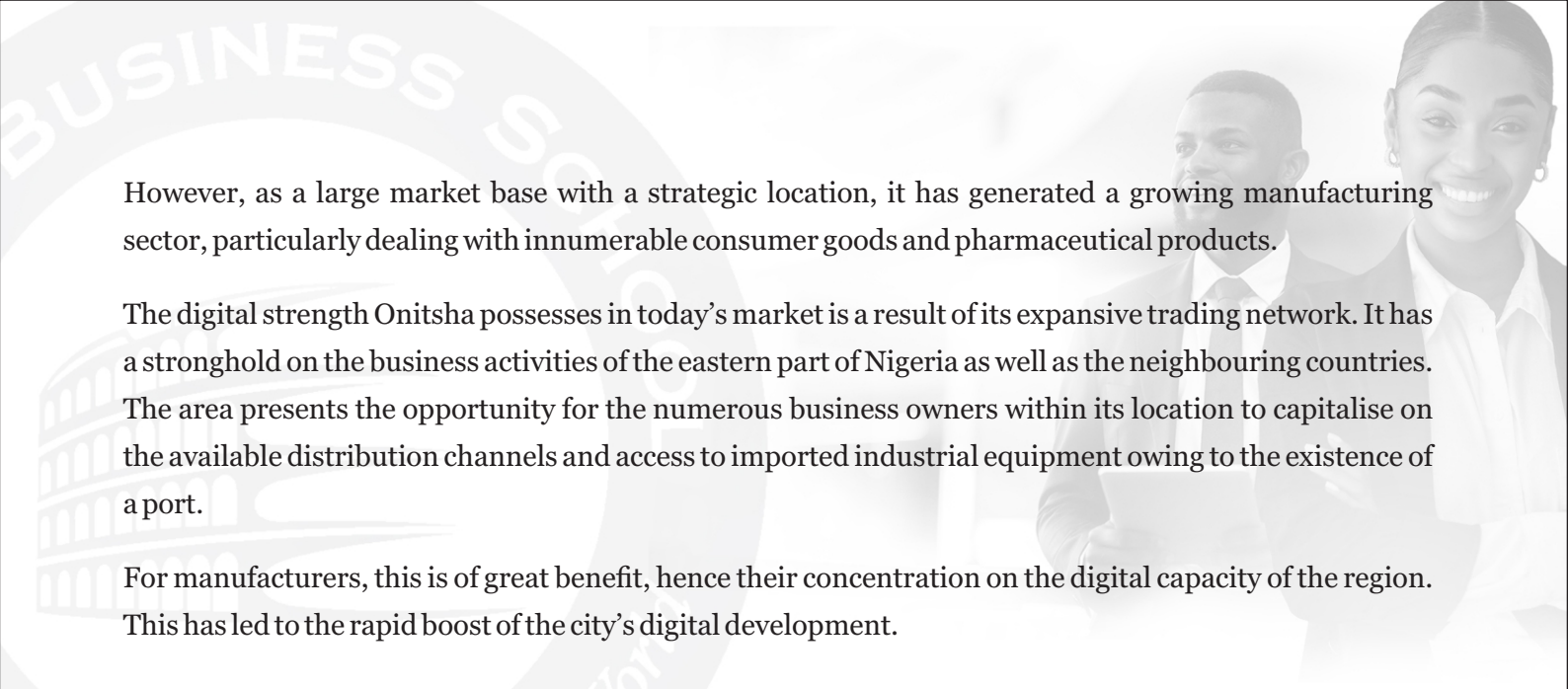
DOA (n.d.). An Investor's Guide To Nigeria's Technology Market.

Adegbiji, A. (2021). An Investor's Guide To Nigeria's Technology Market.

Samson Akintaro (2023). FG set to launch digital hubs in 7 states to empower 1 million youths. [online] Nairametrics. Available at: https://nairametrics.com/2023/08/06/fg-set-to-launch-digital-hubs-in-7-states-to-empower-1-million-youths/ [Accessed 29 Nov. 2024].

Adegbiji, A. (2021). An Investor's Guide To Nigeria's Technology Market.

Statsmetrics.ng. (2024). Nigeria News 24 - Stay Informed with the Latest Updates. [online] Available at: https://www.statsmetrics.ng/article/5-prominent-tech-innovation-hubs-in-nigeria [Accessed 29 Nov. 2024].



However, as a large market base with a strategic location, it has generated a growing manufacturing sector, particularly dealing with innumerable consumer goods and pharmaceutical products.

The digital strength Onitsha possesses in today's market is a result of its expansive trading network. It has a stronghold on the business activities of the eastern part of Nigeria as well as the neighbouring countries. The area presents the opportunity for the numerous business owners within its location to capitalise on the available distribution channels and access to imported industrial equipment owing to the existence of a port.

For manufacturers, this is of great benefit, hence their concentration on the digital capacity of the region. This has led to the rapid boost of the city's digital development.

Atiase, V., Kolade, O. and Liedong, T. (2020) "The emergence and strategy of tech hubs in Africa: implications for knowledge production and value creation," *ScienceDirect*, 161.

Technext. (2023). 5 tech hubs in Nigeria for techies to connect, collaborate, and grow. [online] Available at: https://technext24.com/2023/07/25/5-tech-hubs-in-nigeria-for-tech-bros/.

The Guardian and Awopetun, A. (2023) "How we are positioning Lagos as leading Africa's tech hub,, by Sanwo-Olu," 7 June. Available at: https://guardian.ng/technology/how-we-are-positioning-lagos-as-leading-africas-tech-hub-by-sanwo-olu/

PART THREE

Part Three: Digitalisation, AI, and the Future of Nigerian Business Growth

ROME BUSINESS SCHOOL

3.1 The impact of AI on businesses

Artificial intelligence (AI) has in recent times made significant inroads in the business sector. Although its application is still in the nascent stage in Nigeria, it is widely used in business applications including automation, data analytics, and natural language processing. Numerous businesses and entrepreneurs with the capacity to use advanced technologies have adopted AI for advanced business operations. Nevertheless, AI programmes and solutions have transitioned from being a futuristic and exclusive breakthrough to being easily accessible to all at a reasonable cost.

This accessibility, particularly in Africa, allows even SMEs to adopt AI-aided procedures to boost their competitive advantage and productivity. Research has shown that the application of AI-enabled technology helps businesses in providing recommendations, tracking user habits for digital products, improving and facilitating customer experience and purchasing decisions, virtual or digital assistantship, improving organisational performance and reducing costs. Small business enterprises utilise AI to enhance their customer experience, gather data, and identify available solutions to their specific challenges. AI enables the use of built-in chatbots and voice search prompts to facilitate product discovery, information retrieval, and response to queries.

In Africa, AI holds reasonable possibilities. One of the AI-enabled platforms is UTU Technologies. Founded in 2017 in Nairobi, Kenya, by Bastian Blankenburg, Jason Eisen, Polina Kazak, and Ronald Mahondo, UTU's mission is to empower service providers in sectors such as teaching and information technology to transact and engage in businesses with trust and confidence. It uses AI to generate trust signals with customised recommendations that assist customers in making the best decisions concerning their needs. UTU's taxi service boasts having over one hundred thousand connections on their platform with high-rated drivers.

In healthcare, findings from Zambia show that AI was employed to identify people with diabetes which revealed more accurate data in terms of statistics from human assessment. Google's AI Lab in Accra, Ghana, is working on compression algorithms that can run on the CPU capabilities of mobile phones Agricultural businesses have experienced tremendous support from AI and its related technologies. Agriculture has supported businesses significantly.

The Guardian and Awopetun, A. (2023) "How we are positioning Lagos as leading Africa's tech hub,, by Sanwo-Olu," 7 June. Available at: https://guardian.ng/technology/how-we-are-positioning-lagos-as-leading-africas-tech-hub-by-sanwo-olu/

Africa Tech Schools (2024) *Akure Tech Hub*, *Africa tech schools*. Available at:https://www.africatechschools.com/school/akure-tech-hub

Premium Times and Agency Report (2020) "Ondo attracts $350m FDI in three years - official ," 20 August. Available at: https://www.premiumtimesng.com/regional/ssouth-west/409918-ondo-attracts-350m-fdi-in-three-years-official.html

Akinbolati, A. *et al.* (2020) "Propagation curves and coverage areas of digital terrestrial television base stations in the tropical zone," *Heliyon*, 6(3).

Technext. (2023). 5 tech hubs in Nigeria for techies to connect, collaborate, and grow. [online] Available at: https://technext24.com/2023/07/25/5-tech-hubs-in-nigeria-for-tech-bros/.

AI in South Africa has been used to tackle food shortages through an initiative called “Aerobotics” which was founded in 2014. Aerobotics integrates the knowledge of aeronautics and Machine learning to assess crop health and viability using drones to recognise sick trees, perform pest checks, and offer yield management analysis.

In Nigeria, the impact of AI has been felt in various sectors of the economy, even though its progress has been met with a lot of encumbrances. Research also shows that a health facility based in Nigeria utilised signal processing and machine learning (ML) to improve diagnoses of birth asphyxia. In the fintech industry, Kudi, a fintech company based in Lagos, is ranked as the first AI company in Africa. Through the use of AI chatbots, it narrowed the gap between cash-based trading, categorised as cash notes, and the digital economy. With AI prompts and response systems, this financial technology company creates synergies between consumers of digital products and their goods. Thereby, curbing the disadvantages occasioned by distance and location.

Founded in 2016 by Yinka Adewale and Pelumi Aboluwarin, Kudi collaborates with commercial banks and other financial service providers to deliver various financial products such as deposits, loans, and insurance to small informal enterprises and individuals. According to a report by Fintech Futures, Kudi has built a network of 4,500 merchants and processes over thirty million dollars monthly. In the telecommunications industry in Nigeria, digitisation has had a great impact. For instance, digital broadcasting offers numerous advantages over analogue broadcasting including improved sound quality, signal clarity, and spectrum efficiency. This has enhanced the quality of audio and visual quality in broadcasting and opened up new possibilities for interactive services. Before ICT, communication relied on basic analogue machines with limited capabilities. According to Abuka, technology has vastly expanded broadcasting possibilities, increasing available frequencies for radio and TV, and allowing for interactive services beyond simple signal reception. His findings indicated that 37.5% of respondents agreed digitalization improves sound and image quality, 12.5% noted it expands the available spectrum for program choices, and 16.7% felt it enhances mobile reception of multimedia content. In the Nigerian service industry, AI traction and its attendant effects cannot be overemphasised. For instance, Jumia, one of the largest e-commerce platforms offering a wide range of products including electronics, fashion, and home appliances, uses AI algorithms to analyse customer behaviour and preferences and provide personalised product recommendations based on this analysis.

Joey Off Air and Umahi , N. (2024) “Coworking spaces: the future of Jos' growing tech ecosystem - A deeper insight with Axia,” *News room*. Available at:https://www.joeyoffair.com/coworking-spaces-the-future-of-jos-growing-tech-ecosystem-a-deeper-insight-with-axia-hub/

Ujah-Ogbuagu, B. (2023) “An assessment of the state of digital economy development in Nigeria: A survey,” *Nigeria Computer Society*, pp. 371–380.

Anikeze , N. and Okpalaibekwe, U. (2024) “Digital media tools and youth empowerment in Anambra state,” *Journal of social sciences*, 9(2).

3.2 Driving economic growth through digitalisation

Digitalisation has the potential to improve the economy when adopted and maximised. For digitalisation to boost economic growth, policymakers need to focus on three main activities; designing sector digitization plans, building capabilities, and jumpstarting and monitoring wider organizational initiatives. By creating new pathways for growth, policymakers can develop competitive advantages and create previously inconceivable job roles. Developing the capacity to fill these roles and partnering with industry experts, consumers, and government agencies to monitor processes is essential. The ability of digitalisation to increase output has measurable global consequences.

In 2011, digitalisation contributed an additional $193 billion to global revenue and generated about 6 million. Adapting national economic strategies to accumulate more digital resources and services allows proportional expansion. A 2013 report by PwC notes that the economic effect of digitisation accelerates as countries migrate to advanced levels of digitisation. An ICT-enabled business ecosystem allows capitalisation of the benefits of digital tools, while digitally constrained economies reap lesser benefits due to a lack of any input in digital resources or investment. A case in point on the driving economic growth through digitalisation is the e-commerce business sector.

Electronic commerce (e-commerce) involves using the internet to market, identify, pay for, and deliver goods and services. The internet has revolutionised business transactions, allowing customers to invest, purchase, distribute, and communicate from anywhere with internet access. E-commerce is a crucial digital strategy for marketing and sales today, proving to be a reliable market force compared to physical stock and market forms.

Global e-commerce is dominated by China, with revenues valued at USD 2.17 trillion in 2023. The key factors driving this surge include gross domestic product (GDP) per capita, consumer spending per capita, internet penetration, and population size.

E-commerce offers a plethora of opportunities to large, medium and small-scale enterprises to operate in the global marketplace, and for regional businesses and communities to participate in social, economic and cultural networks seamlessly across international boundaries.

Kabir, M. E. (2020). Artificial Intelligence in Business and Future Prospect. *IAR Journal of Entrepreneurship, Innovation & Design Thinking*, 1(1).

Iansiti, M., & Lakhani, K. R. (2020). Competing in the age of AI: Strategy and leadership when algorithms and networks run the world: Harvard Business Press.

Chan, C. M., Teoh, S. Y., Yeow, A., & Pan, G. (2019). Agility in responding to disruptive digital innovation: Case study of an SME. Information systems journal, 29(2), 436-455.

Ebuka, A.A., Emmanuel, D. and Idigo, P., 2023b. Artificial Intelligence as a catalyst for the Sustainability of Small and Medium Scale Businesses (SMEs) in Nigeria. *Annals of Management and Organization Research*, 5(1), pp.1–11. https://doi.org/10.35912/amor.v5i1.1719.

Burian, J. (2020). The complex choreography of supply chain resilience. Industry Week

In 2020, the number of Internet marketplace visitors in Nigeria grew above 242 million and online electronics sales surpassed 2.4 billion U.S dollars. The internet has without a doubt offered very positive opportunities to people and businesses to transact.

Since the advent of the internet, start-ups and other pre-existing businesses have been empowered to operate with consistency and at reduced costs. Today, digitising businesses brings people closer to their demands, enhancing organisational processes with technological applications and new economic paradigms.

Jumia and Konga are referred to as the 'Beasts' of e-commerce in Nigeria, offering vast and easily accessible retail services.Digitalisation, enabled by the ICT industry, has become the primary driver of growth in the Nigeria economy. It has aided e-commerce (that is, inter-organisational business transactions) and e-businesses (which involves transactions between a business and a person or people). Research indicates that e-finance, encompassing e-banking and payment systems, is widely accepted in Nigeria. It is estimated that over 90% of Nigerian banks transact online and offer real-time services, allowing customers to perform transactions from the comfort of their homes or offices. Credit and debit cards, virtual cards, and ATMs function as digital tools for these transactions, highlighting the transition in Nigeria's business terrain.

Digitalisation has shown the capacity to boost economic growth in Nigeria. The coming of e-commerce has brought opportunities for the future generation of creative young individuals in the country and these individuals will in turn contribute to the nation's technological growth.

3.3 The future of businesses and Digitalisation in Nigeria

The future of business and digitalisation in Nigeria lies on several critical factors, including population, particularly of internet users, the literacy level of the population, and the availability of digital tools. According to the Internet World Start (2014), there were 200,000 Internet users in Nigeria in the year 2000. By December 31, 2016, the internet users stood at 86,219,965 representing 46.1% of the total population. This shows an increasing number of users of the Internet in Nigeria from 0.1% in 2000 to 46.1% of its population in 2016 as shown in the table below.

Sampene, A.K., Agyeman, F.O., Robert, B. and Brenya, R., 2022. *Artificial Intelligence as a Path Way to Africa's TransformationS*. [online] unknown. Available at: <https://www.researchgate.net/publication/358440753> [Accessed 19 November 2024].

Bellemo, V., Lim, Z.W., Lim, G., Nguyen, Q.D., Xie, Y., Yip, M.Y.T., Hamzah, H., Ho, J., Lee, X.Q., Hsu, W., Lee, M.L., Musonda, L., Chandran, M., Chipalo-Mutati, G., Muma, M., Tan, G.S.W., Sivaprasad, S., Menon, G., Wong, T.Y. and Ting, D.S.W., 2019. Artificial intelligence using deep learning to screen for referable and vision-threatening diabetic retinopathy in Africa: a clinical validation study. The Lancet Digital Health, 1(1), pp.e35–e44. https://doi.org/10.1016/s2589-7500(19)30004-4.

Ibid (n-6)

Nanalyze, 2019. *Top-10 Artificial Intelligence Startups in Africa - Nanalyze*. [online] Nanalyze - A community of sensible investors. Available at: <https://www.nanalyze.com/2019/04/artificial-intelligence-africa> [Accessed 19 November 2024].

Ibid pages 14942-14943.

As of 2024, Nigeria boasts a significant number of internet users. According to DataReportal, Nigeria has over 150 million internet users, representing approximately 70% of the population. Additionally, digital literacy is on the rise in Nigeria, with the government's "3MTT" initiative aiming to train three million technology talents by 2030.

This push towards digital education is expected to significantly enhance the digital skills of the population, making them more adept at leveraging digital tools and technologies. The availability of digital tools and infrastructure is improving, with investments in broadband connectivity and digital platforms. The World Bank's Digital Economy Diagnostic Report highlights the importance of developing digital infrastructure to enable digital transformation. As earlier noted, the outlook of digitalisation in Nigeria is not impeccable, however, it has moved from being surreal to a concrete and tangible one. Digitalisation has reformed economic landscapes and served as a catalyst with rife impacts for the past two decades.

The future of digitalisation and business in Nigeria cannot be fully examined without ample consideration of the scope and dimensions of telecommunication. Since the review of the National Policy of Telecommunications in 2000, changes in technology, standards and markets have defined the trajectory of the next phase of one of Nigeria's fastest-growing sectors. Despite being plagued with issues such as spectrum management, convergence, universal access, broadband penetration, net neutrality and Quality of Service (QoS) have transformed significantly from when the last policy was issued. Research has shown that technological applications of AI are rapidly spreading in the telecommunications industry.

Artificial Intelligence (AI) and the Internet of Things (IoT) are being used to improve service quality in various industries, including telecommunications. Nigeria is currently experiencing the rise of new technologies, which has set the country on the wheels of a digital revolution. There is rarely an aspect of the citizens' lives that does not require one type of digital skill or another, ranging from operating household electronic gadgets to using smartphones to doing online banking, using e-government platforms, online job applications, e-learning, flights and appointment bookings. The mode of work has changed and some companies are building into the future and capitalising on the essence of digitalization and the adoption of artificial intelligence in businesses .

Futures, F., 2019. *Kudi raises $5m to expand bank agent network in Nigeria - FinTech Futures: Fintech news*. [online] FinTech Futures. Available at: <https://www.fintechfutures.com/2019/04/kudi-raises-5m-to-expand-bank-agent-network-in-nigeria/> [Accessed 19 November 2024].

Ojelade, M., Aransiola, I.J. and kolawole, A. J., 2023. *DOC-20231204-WA0028. (1)*. [online] unknown. Available at: <https://www.researchgate.net/publication/382149593> [Accessed 20 November 2024].

Ibid (n-14) page 53.

Nwachukwu, Affen, D., Miebi, 2023. Artificial Intelligence Marketing Practices: The Way Forward to Better Customer Experience Management in Africa (Systematic Literature Review). *International Academy Journal of Management, Marketing and Entrepreneurial Studies* , 9(2). https://doi.org/ 27214256637924.

Digitalisation spurs the development of new industries and subsequently becomes the pillar that creates a stronghold for a thriving economy. With the creation of internet services and advanced broadband networks, a high percentage of the population depends on online platforms and services for their business transactions, communication, skill learning and business research .

The data provided by the National Bureau of Statistics (NBS, Dec. 2020) revealed that the contribution of digitalisation to the country's GDP increased from 12.46% in Q2, 2015 to 17.83% in Q2 2020, and there is an expectation of a triple increase by the 2030s. This is a higher percentage than the oil sector contribution to the GDP (8.9%) in the same quarter.

Telecommunications and Information Services are two sub-sectors that have subsequently continued to make great contributions to the growth and development of digitalization in Nigeria year after year. To improve the digital economy, it has become necessary to develop a large pool of digitally literate citizens. Thus, a need to develop the digital sector and proliferate the emergence of new digital entrepreneurs.

3.4 The talent gap for digitalisation and AI in Nigeria

Despite the increasing level of digital adoption in Nigeria, there is an existing talent gap in digitalisation and AI. Digital divide or technological gap refers to the disparity in terms of socioeconomic levels of access to information and communication technology that persons, households, businesses, and geographical territories experience as well as their use of the internet for specific purposes. This implies that availability, reachability and usability are the major determinants of the technological divide in any given territory or group.

The technological divide is simply the line that separates people with access to computers, internet use and the required skills from those who have neither of these. According to Vanguard News, Nigeria ranks 73rd out of 83 countries on the Global AI Index, scoring poorly in talent, infrastructure, and operating environment.

This is a result of a number of factors that have been a bane to the general usage of advanced technological tools and digitisation of the economy. It can exist between people who live in rural areas, between the educated and the illiterate, people from diverse socioeconomic strata, and globally between countries.

Ibid (n-15)
PwC. digitisation for economic growth and job creation: Regional and Industrial Perspective.
Ibid (n-17)
Okolie, U.C. and Ojomo, A.H., 2020. E-Commerce in Nigeria: Benefits and Challenges. *Humanities and Social Sciences: Latvia*, 28(2), pp.69–90. https://doi.org/10.22364/hssl.28.2.05.
Anggraeni, L. et al 2024. E-commerce's Impact on Economic Growth. *Nomico*, 1(6). https://doi.org/10.62872/jagdc251.
Mary-Anne, G. (1998). "E-commerce awareness programme for regional communities". Journal of Internet Banking and Commerce, 3(2): pp. 23–31.
Sasu, D.D., 2023. *Topic: E-commerce in Nigeria*. [online] Statista. Available at: <https://www.statista.com/topics/6786/e-commerce-in-nigeria/#topicOverview> [Accessed 26 November 2024].

These causal factors range from internal or individual idiosyncrasies to external causes, and some of them are digital illiteracy, opaque regulations and regulatory measures, data breach and theft, availability and accessibility of technological tools, location, affordability and cost among others.

In Nigeria, research has shown that over 70% of the population resides in rural areas. Due to this demerit, the government has to make concerted efforts to get ICT tools to these areas as well as educate them. The talent divide in Nigeria can also be said to result from social isolation, difficulty in accessing (digital) education, and social isolation.

People living in rural areas without internet connectivity are entirely cut off from the world, and the lack of ICT centres makes it even more difficult for financially disadvantaged individuals to acquire digital skills and contribute to the pool of digital talents.

However, the Government of Nigeria has made considerable efforts, such as the Digital Nigeria Campaign, which was initiated in the 2000s. Also, the 3MTT initiative of the government as earlier mentioned has shown that Nigeria is gearing up to lead the IT space in Africa.

According to IT Talent Gap Assessment in Nigeria by the Co-Creation Hub Research Team, "Nigeria now leads Africa in the vitality of its tech talent and has made significant strides in the growth of its tech talent over the past decade." According to Bright (2016), many young Nigerians living overseas are returning home to develop and start digital businesses because the country's tech sector has grown so rapidly over the past decade.

This is to say that, the digital lacuna that existed in Nigeria due to challenges which have been highlighted earlier is narrowing because individuals as well as the government have risen to tackle these challenges. The report of this assessment further remarks that in 2021, the start-up ecosystem in Nigeria attracted about $1.8 billion USD which accounts for 35% of the investment in Africa. Consequently, efforts are currently being made to mitigate the lacuna experienced in the use of digital technologies such as AI, cybersecurity, e-commerce, cybersecurity and others. Colluding with this, Cullen Rowen as cited by Sunday et al remarks that to reduce the digital divide in Nigeria there is a collaboration between government and technology corporations like Google, Cchub, Andela, StarBridge Africa, Microsoft and Intel.

Ibid (n-21) page 70.
Ibrahim, I. A., & Abubakar, M. (2015). "Technological adoption of e-commerce in Nigeria". International Journal of Innovative research in Engineering & Management, 2 (6): pp.1–7.
https://www.itedgenews.africa/itedgenews-com-report-6/
Ibid (n-21)
Ibid (n-21)
Kuliya, M. (2015). "The impact of information and communication technology in the growth of e-commerce in Nigeria: Challenges and prospects". *International Journal of Scientific and Research Publications*, 5(12): pp. 507–512.

Furthermore, with a population of about 206 million (as of 2020), a developing middle class and a sizable young market, Nigeria, is without a doubt Africa's largest market, and about a third of the population between the ages of 15 and 35 is thought to represent a growing pool of tech-savvy people ready to embrace the latest innovations as they become available.

For example, MainOne, a Nigerian-based company continues to invest significantly in growing and covering the broadband ecosystem in West Africa and growing its leadership position in the industry. From its earliest investments of over $240 million to deploy a world-class submarine cable system, followed by investments in a next-generation IP NGN network, a growing regional and metro terrestrial fibre-optic network and a Tier III Data Centre, MainOne aims at over $100 million within the next five years as a sign of its commitment to improving broadband services in West Africa.

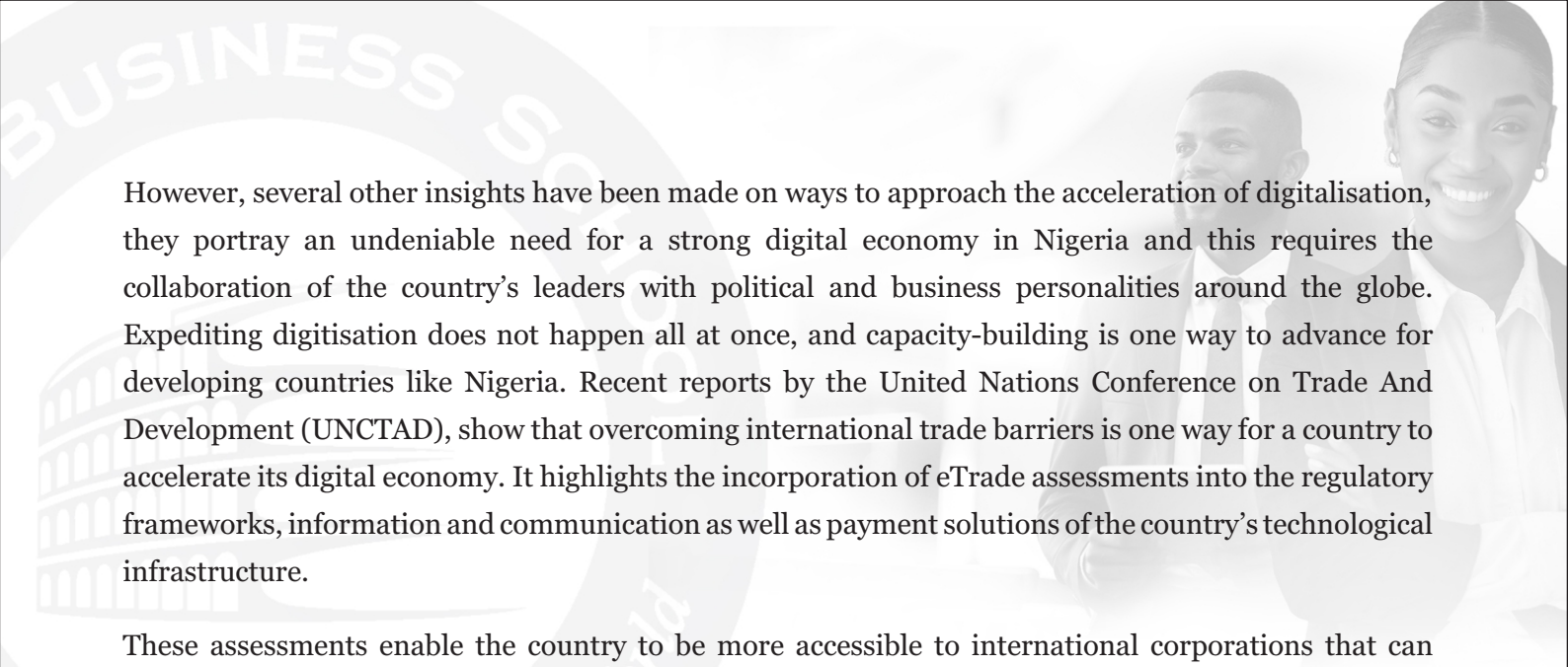
3.5 Accelerating digitalisation in Nigeria

The past decade in the Nigerian economy has experienced a transformation due to the emergence of digitalisation. Although this has resulted in an increase in the amount of products and services that are made available in the different sectors and markets of the country, it does not detract from the stakeholders' decisions regarding the need for more advancements. A good number of economies in the world have begun employing the use of digitisation to advance their development and Nigeria, being a country with already implemented ICT policies which will serve as catalysts for achieving more goals, is ready for such growth . A country's image is influenced by its business policies and the existence of a digital presence. This is the potential on which digital acceleration is based and how it drives economic reform and productivity into the technology infrastructure of Nigeria . .

In 2022, a lot of variables were considered by the President of Nigeria Computer Society (NCS), Prof. Adesina Sodiya, for the expansion and reshaping of every economic sector that has already built facilities with digital technology. One of these variables by which Nigeria can accelerate its digital growth is inclusive of a marginalised structure, this implies that age groups should be divided based on their capabilities to provide sustainability and development . In other words, it does not pave the way for inequalities, rather it offers innovative strategies which can only be handled by able-minded persons to propel digitalisation into the economic sector by harnessing its potential for more growth.

https://datareportal.com/reports/digital-2022-nigeria?form=MG0AV3
https://www.worldbank.org/en/country/nigeria/publication/nigeria-digital-economy-diagnostic-a-plan-for-building-nigerias-inclusive-digital-future?form=MG0AV3
https://documents1.worldbank.org/curated/en/387871574812599817/pdf/Nigeria-Digital-Economy-Diagnostic-Report.pdf?form=MG0AV3
Ibid (n-14) page 3.
Ibid (n- 31)
Busayo, T., Igbekoyi, O., Oluwagbade, O., Adewara, Y., Dagunduro, M., & Boluwaji, Y., 2023. *View of Artificial Intelligence and Service Quality of Telecommunication Firms in Nigeria*. [online] Journal of Economics, Finance and Accounting. Available at: <https://al-kindipublisher.com/index.php/jefas/article/view/5475/4656> [Accessed 21 November 2024].

https://www.worldbank.org/en/country/nigeria/publication/nigeria-digital-economy-diagnostic-a-plan-for-building-nigerias-inclusive-digital-future?form=MG0AV3



However, several other insights have been made on ways to approach the acceleration of digitalisation, they portray an undeniable need for a strong digital economy in Nigeria and this requires the collaboration of the country's leaders with political and business personalities around the globe. Expediting digitisation does not happen all at once, and capacity-building is one way to advance for developing countries like Nigeria. Recent reports by the United Nations Conference on Trade And Development (UNCTAD), show that overcoming international trade barriers is one way for a country to accelerate its digital economy. It highlights the incorporation of eTrade assessments into the regulatory frameworks, information and communication as well as payment solutions of the country's technological infrastructure.

These assessments enable the country to be more accessible to international corporations that can identify the opportunities it offers and involve the bigger community of investment partners to key into what the country offers .

The strategic road map and action plan for Nigeria, formulated by the National Information Technology Development Agency embodies the alignment of the goals of the government agency under the direction of the minister of communication, innovation and digital economy, with the precis of adopting and regulating technology into implementing growth.

According to the plan, digital literacy programmes would be run for the 3.3 million Nigerians who require this education. Also, more initiatives are being mapped out to enhance the fortification of cybersecurity. This would be done to build safe practices in the electronic transactions of the country. The goal is to digitally empower Nigeria and the major strategy to be employed is to build a robust and digitised technological ecosystem which fosters a more productive economy and increases healthy global competition .

Shettima, M. and Sharma , N. (2020) "Impact of digitalisation on small and medium enterprises in Nigeria," *Adalya Journal* , 6(11).
Olurinola, I. *et al.* (2021) "Digitalization and innovation in Nigerian firms," *Asian economic and financial review*, 11(3).
Akanbi, B.E. and Akanbi, C.A., 2012. Bridging the Digital Divide and the Impact on Poverty in Nigeria. *advances in multidisciplinary & scientific research journal publication*, 3(4), pp.81–87. https://doi.org/10.22624/aims/cisdi/v3n4p2x.]

PART FOUR

Part Four: Ethics and Governance in Digitalisation

ROME BUSINESS SCHOOL

Digitisation is the product of converting information and data from physical forms to digital forms in order to leverage business opportunities.

In order to operate a streamlined business ecosystem, codes of conduct that guide and specify the modes of operations of digital technologies like artificial intelligence, blockchain technology, e-commerce and so on, in alignment with specific human values and morals are enacted.

Therefore, ethics and governance in digitalisation imply rules or principles that monitor and regulate the activities or tools of digital economies to conform with the humanitarian demands of every nation which forms the primary essence of its invention.

4.1 Ethical Considerations in AI and Digitalisation

Despite the diverse pros of Artificial Intelligence (AI) and digitalisation in diverse sectors of nations' economies in the past couple of years, there have been ethical concerns about their adoption by individuals and corporate bodies at the local, regional, national and supra-national levels. In Nigeria, based on the National Artificial Intelligence Strategy, "The growing dependence on digital assets and the escalating nature of cyber threats emphasise the urgent need for strong cybersecurity measures to protect against potential threats in Nigeria's rapidly changing digital landscape." Another challenge with considerable damage to the integrity of the digitalisation of economies is hacking. This is said to be fostered by issues of data breaches caused by non-authorisation and lack of consent . Jessica Morley notes that "Algorithmic activities, like profiling, can lead to challenges for autonomy and informational privacy.

For example, Polykalas and Prezerakos (2019) examined the level of access required to personal data by more than 1000 apps listed in the 'most popular' free and paid-for categories on the Google Play Store. They found that free apps requested significantly more data than paid-for apps, suggesting that the business model of these 'free' apps is the exploitation of personal data."

From the foregoing, it could be inferred that, cyber threats and data breach arise from either diversion of sensitive data or impersonation where personalised information is used for fraudulent reasons.

Edet Ani, O., Uchendu, C. and Atseye, E.U., 2007. Bridging the digital divide in Nigeria: a study of internet use in Calabar Metropolis, Nigeria. *Library Management*, 28(6/7), pp.355–365. https://doi.org/10.1108/01435120710774495.

–Talent gap, infrastructure, others may delay Nigeria's AI growth ISACA Lagos - Vanguard News

Sunday, O., Umeifekwem, U., and Eme, O., 2023. Addressing Digital Technology Gap: The Nigerian Experience . *Nigerian Journal of Social Development*, 11(1).
https://doi.org/https://www.arabianjbmr.com/pdfs/NGJSD_VOL_11_1_2023/9_ngjsd_2023_1.pdf .

Ibid (n-43)

Ibid (n-43)

Co-creation Hub Research Team, 2022. *IT Talent Gap Research Summaries copy*. pp.1–30. https://doi.org/https://nitda.gov.ng/wp-content/uploads/2023/01/IT-Talent-Gap-Research-Summaries-copy-1.pdf.

Due to these uncertainties and queries about how automated systems and digital technologies utilise the volumes of data and information at their disposal, it became pertinent for checks and balances, known as ethics and regulation, to be put in place. Ethics and regulation are described as codes of conduct that encompass avoiding bias, ensuring the privacy of users and their data, and negotiating environmental risks .

Navigating the intricacies of such a volatile system in Nigeria has been underway. However, popular participation seems hampered because of the lack of necessary knowledge of electronic information resources (EIR), hardware operations, lack of ethical browsing skills, financial problems in procuring EIR gadgets, unethical information overload, funding, inconsistent electricity supply, poor ICT infrastructure, due to insufficient knowledge of software applications usage were faced by the students when using the internet. Some developed economies like the United States, the United Kingdom, China, Japan and others have been very efficient in the use of artificial intelligence to engender the all-round revitalisation of their economic landscapes.

For instance, On May 23, 2012, President Obama issued a directive entitled "Building a 21st Century Digital Government." The aim of this was to set up a government strategy that would secure, curate and ensure a safer online or digital experience for the American people. This regulatory directive is hinged on many initiatives such as Executive Order 13571, which was to ensure streamlined service delivery as well as an enhanced customer experience for businesses and products, and Executive Order 13576, which focused on delivering an efficient cum effective government — a government that is laudable . One of the primary dictates of this regulative order is that it requires companies developing large-scale AI systems that could affect national security, public health, or the economy to test these systems and report results to the government. It also orders rules to be drafted around federal procurement of AI, which will have a large impact due to the government's role as a major purchaser of advanced technology like AI .

The concept of ethical implementation of unique guidelines in today's business terrain stems from issues such as data privacy, traceability and others which have been sustained over time. The process which informs the implementation is termed "AI governance." AI governance focuses on transitioning principles to tangible actions that are effective in cushioning mankind against the adverse implications of AI dependence and digitalisation of economies such as e-commerce approaches like virtual and mobile

Ibid (n-45) page 6.
Ibid (n-43) page 97.
Okonji, E., 2024. *Bridging Nigeria's ICT Infrastructure Gap – THISDAYLIVE*. [online] THISDAY. Available at: <https://www.thisdaylive.com/index.php/2016/11/24/bridging-nigerias-ict-infrastructure-gap/> [Accessed 21 November 2024].

banking, and cryptocurrencies. AI governance functions as the holistic approach to ensuring proper monitoring and mitigation of the negative outputs of artificial intelligence tools . These regulations function as consolidated legal and policy frameworks that safeguard against the risk associated with AI and digitalisation implementation to make it safer for businesses and stakeholders.

In the Nigerian business setting, ethical concerns about digitalisation and AI stem from a vast range of reasons. The use of social media which is today a major tool for both communicating and carrying out transactions plays a major part in this issue of the corrosive impacts of advanced technologies. These issues extend beyond individual experiences and have far-reaching implications for Nigerian society, including public health, elections, security, and societal cohesion .

Primarily, aspects of ethical consideration include bias, data privacy and authenticity, transparency, and accountability. These are discussed as follows:BiasBiases in digitalisation and AI refer to curating machine learning algorithms that are trained on data that only highlights specific demographic groupings or reflects social biases .

The biases of a system can be a result of the data used to train the system or from the value attached by the creator and users. They are imputed by the creator in the machine learning language (ML) such as algorithms which are trained on data that only insight specific demographic groups or reflect on social biases. The consequence of such bias is that a wrong judgment may be given against a group. For instance, if used in law and detection by a security agent, it may lead to wrongful judgment and imprisonment or detention of that group. Bias, here, highlights the subjectivity of AI systems which tend to reflect the mindset of their developers, and as such hinder issues from being addressed in certain logical and unique ways per time.

Privacy

The concept of privacy is broad. Hence, privacy according to American professor Tom Gerety is “the control over or the autonomy of the intimacies of personal identity.” Artificial intelligence can extract sensitive details of humans like fingerprints, oral idiosyncrasies, images and facial profiles, to aid security measures within and outside territories. However, it may sometimes be misused by certain sectors like marketing and retail services.

Oluwasemilore, I. (2023) “Challenges of Nigeria's Digital Economy,” *UCC Law Journal* , 3(1).
Adejumo , D. and Wynn, M. (2024) “The role of digitalisation in shaping a country's image ,” *Research Gate* , 23(1).
Nigeria Computer Society (2021) “Prof. Adesina Sodiya's 20 months stewardship as president of NCS,” *C- Voice*, 3(5).
United Nations Conference on Trade and Development (2024) *Digital Economy Report 2024*. Unctad.org, pp. 105–116.

This data is utilised by AI to enhance consumers' experience by providing them with personalised or relevant recommendations. This collection of consumers' personal data can pose a substantial threat to their privacy. In Nigeria, privacy violations are sometimes motivated by the quest for sensational news or as payback for ills done by individuals and can bring about distrust . This is to say that one's personal activities can be exposed for the sheer sake of revenge and spite.

Transparency

This ethical concern can be said to arise from the inability of digital systems and AI to offer explanations as to how they use human data and information . As a result of this, algorithms and protocols which inform their operations stretch to include areas which it had initially not intended or expected to.

The foremost ethical concern in the use of AI and digital technologies in digital marketing is transparency. Consumers more frequently have no knowledge that they are being tracked and how their data is being collected and used for decision-making by AI.

Therefore, they are often called the "Black Boxes" which make it hard to understand for the users how their data is being tracked and used for marketing. As a result of the imperceptible limits of AI and digitised tools, there exists an innate degree of alarm and caution as to how man relates and utilises AI and its accompanying technological tools.

However, some other nations of the globe are more keenly engaged in trailing the limitless possibilities of an AI-based and digitalised economy than they are about the insidious damage it could occasion (ref, also support this with examples from where you got this information). This is the foundation bedrock of ethics-washing which indicates — the practice where organisations make hollow or superficial commitments to ethical principles to detract from unethical practices or to gain trust without making substantial changes to their behaviour .

In relation to AI and digitalisation, ethics-washing "Is the way in which companies use ethical guidelines as a marketing tool rather than a framework for responsible action."

One of the notable scandals of digital technologies has been the Cambridge Analytica and Facebook Scandal.

National Information Technology Development Agency (2023) *National Digital Literacy Framework*, pp. 17–23.
National Artificial Intelligence Strategy (2024), page 63
Sam, Anamoji (2023). Ethical and Regulatory Framework Of Artificial Intelligence (A.I) in Nigeria: The Dilemma of Global Adaptation for Sustainable Growth, page 62.

According to The Times, "Cambridge Analytica, eager to sell psychological profiles of American voters to political campaigns, acquired the private Facebook data of tens of millions of users — the largest known leak in Facebook history."

Aside from data theft, transparency, infringement, authenticity and accuracy, data piracy, etc., form the bulk of reasons for man's doubtful queries regarding digital technologies and artificial intelligence. Because of the non-compliant attitudes of regional bodies and organisations, the onus is on states to draft up principles and ensure due compliance of all and sundry to these ethics in a way that is not bureaucratic or unrealistic.

In the Nigerian business ecosystem, to tackle the issues of transparency, the Executive Order on the Promotion of Transparency and Efficiency in the Business Environment was created in May 2015.

4.2 Regulatory Frameworks and Compliance in Nigeria

In Nigeria, the growth of digitalisation and AI is impeded by a lack of an exclusive AI legal framework to take care of the ethics and regulations. Other challenges that hamper the paradigmatic surge of AI in Nigeria include a lack of adequate knowledge about AI, and infrastructure decay. These challenges put Nigeria far below the index of countries with AI readiness. According to Oxford Insights, in its "Governance, AI readiness index 2020, Nigeria ranks 138 globally and 20 in the African region with South Africa, Kenya and Ghana on top."

Poised to make an impact on the continent as the leading AI country, Nigeria regulates and ensures compliance through the National Informational Technology Development Agency (NITDA). Also, NITDA dedicated a department called the National Centre for Artificial Intelligence and Robotics (NCAIR) on November 13th, 2020, to the development, research and promotion of AI for the nation's interests.

Through this arm of NITDA, reforms have been made to tackle the basic challenges faced in the digital space. The avowed values of this agency are lawfulness, ethicality, robustness, explainability, privacy and data governance, social and environmental well-being, and so on.

Morley, Jessica et al (2019). From What to How: An Initial Review of Publicly Available AI Ethics Tools, Methods and Research to Translate Principles into Practices, page 2143.
Sam, Anamoji (2023). Ethical and Regulatory Framework of Artificial Intelligence (A.I) in Nigeria: The Dilemma of Global Adaptation for Sustainable Growth, page 62.
Otunugbu, D. & Ogunobo, M. (2022). "Ethical Issues and Information Communication Technology (ICT) use in the New Era." *International Journal of Knowledge Content Development & Technology Vol.12, No.3 (September, 2022)*
Digital Government Strategy (2009 - 2017). United States Department of State. Available at: https://2009-2017.state.gov/digitalstrategy/

The council is the innovative body of the government responsible for research and further understanding of the application and use of emerging technologies like Artificial Intelligence, Deep Learning, Extended Reality (XR-VR/MR/AR), Robotics, Drones, and the Internet of Things (IoT). In the same vein, Sam Anamoji has in his study highlighted some of the promulgations and bodies set up to tackle AI and digitisation in Nigeria, thus:

1) The Startup Act, 2022

2) The Data Protection Act, 2023. The Nigerian Sovereign Investment Authority (NISA) is the institution that manages the funds as a facilitator rather than a regulatory body of AI for data processing, fiscal incentives and technological transfer.

3) The ARCON Act 2022 is for advertising and application of AI Licences before getting released to the public.

Nigerian Centre for Artificial Intelligence and Robotics (NCAIR), 2020. This is a government initiative saddled with the responsibilities of research and further understanding of the application and use of emerging technologies like AI, deep learning, extended reality (XTVR/MR/AR), Robotics, Drones and the Internet of Things (IoT) .

It is poignant, however, to note that the aforementioned bodies and promulgations are implemented by the National Information Technology Agency (NITDA) which is the main regulatory body for monitoring and ensuring compliance of AI to statutory guidelines.In collusion with The Economist, the world's most valuable resource is no longer oil, but data. Data is the oil of the digital era .

Data in today's world informs the decision-making processes of most institutions globally, ranging from numeric to alphabetic, and also a medley of both for diverse purposes. NITDA through the National Artificial Intelligence Agency asserts that both AI and digitalisation depend on data.

Ibid (n-75)
Ibid (n-67), page 56.
Ibid (n-67).
Adams, E. & Baba, D. (2024). Ethical Issues of Social Media in NIgeria. *Indonesian Journal of Public Administration, Vol. 1, No. 2*
Ibid (n-67).

This makes the National Data Protection (NDP) Act 2023 statutes protect data subjects and guide the processing of personal data essential. It highlights the primary responsibilities of the National Data Protection Act of 2023 as follows:

1. Responsible data collection to facilitate the collection of only the relevant and appropriate number of data required for a particular purpose.

2. Individual rights. This ensures that AI experiments are in alignment with the rights of individuals in society.

3. Data security. This principle abrogates fraudulent sharing or utilisation of sensitive data by AI systems.

4. Transparency and trust. Primarily, these guidelines ensure compliance with the manner in which AI and other digital technologies manipulate data. Here, data for AI testing and implementation must reflect and uphold the due rules that are pertinent to its specific processes .

Based on the 2023 Government AI Readiness Index, Nigeria ranks sense on the scale of African countries with High AI-focused implementation strategies. In a positive contrast to 2020's Oxford Insight AI Readiness Index, Nigeria 2023 ranked seventh in the African sub-Saharan region. This is an indicator of progress, regardless of its slow pace.

As such, it could be inferred that Nigeria not only possesses the potential to rise to the apogee in Africa as An AI giant but has already begun to implement vital strategies to ensure she takes her place in the situation of AI evolution in Africa. Also, some of the regulatory policies enacted to facilitate digital technology are online safety and security of citizens as part of the purview of Cybercrimes (Prohibition and Prevention, etc.) Act 2015.

Its 2024 Amendment Act addresses cyber threats and online safety. Cybersecurity is required within the AI strategy, incorporating cybersecurity measures specific to AI systems, mitigating potential vulnerabilities, and ensuring the security of AI-powered applications.

Ibid (n-67).
Gerety, T. (1977). "Redefining Privacy." *Harvard Civil Rights-Civil Liberties Law Review* Vol. 12, No. 2. p. 281.
Yi Zhang, M. W. (April 2021). Ethics and privacy of artificial intelligence: Understandings from bibliometrics. Knowledge-Based Systems, 222.
Ibid (n-19).
Ibid (n-66).
Wigmore, I. (August 2019). Black box AI. TECHTARGET NETWORK. International Journal of Internet, Broadcasting and Communication.

From the foregoing, it is imperative to say that AI innovation and digital technology in Nigeria are taking a direct and more sustained turn, but it is plagued with issues such as lack of proper funding and other national-level challenges that cut across the labyrinths of society and governance.

4.3 Maintaining a responsible digital footprint

From valid indications stated above, artificial intelligence is a scientific cum technological innovation that is indispensable to today's global world, and as such cannot be proscribed because of the array of endless possibilities that abound within this terrain. Digital footprint as a concept in technology is the impact made in the course of using and experimenting with technological tools.

Nigeria can achieve a safe and enabling environment for the deployment of AI systems and an adequately digitised economy to maximise its potential while curtailing its negative effects.

Sam Anamoji believes that "It is the structural measures in Europe which should be considered by the Nigerian policymakers in creating a proper AI framework for Artificial Intelligence in the country. A solid framework must envisage a synergy between the private sector and the governance body."

This implies the concept of trust and transparency between facets of governance or arms concerning the operations of various forms of digital economies like blockchain technology and AI which could encompass a large area of national operations when they are efficiently harnessed.

For instance, in alignment with international standards, The People's Republic of China's Ministry of Science and Technology (MOST) formed a National Governance Committee for New Generation Artificial Intelligence and published the governance principles for new-generation artificial intelligence.

In essence, the Chinese AI governance approach is focused on security and privacy, safety and reliability, openness, accountability, and justice, all of which are factors that other countries should consider in their technological aspirations.

Also, sustaining a sound digital footprint entails a human-centric deployment of AI skills and creating a digital economy that arises from the core of human morals. Affirmatively, Sam Anamoji states that in the use of AI and other forms of digitised technology, it is crucial to ensure that AI application is pro-people,

Papyglev Gleb & Chan Keith (2024). *Fugazi Tolerance for AI : Strategi Tolerance for Ethics Washing.* Available at: https://link.springer.com/article/10.1007/s00146-024-02084-x#Sec8

Wagner B (2018) *Ethics as an escape from regulation*. From "ethics-washing" to ethics-shopping? Amsterdam University Press, Amsterdam, pp 84–89

The New York Times. *Cambridge Analytica and Facebook: The Scandal and the Fallout So Far*. Available at:https://www.nytimes.com/2018/04/04/us/politics/cambridge-analytica-scandal-fallout.htl

or humancentric to avoid the risks of destroying the citizens' moral and ethical values or even driving them out of jobs, exposing them to unforeseen harm, deprivation of communicational intentionality, etc. This existential concern corroborates with the ethical and human-based principles as captured by the Global Standards on Artificial Intelligence, December 2020 .

These principles include freedom and autonomy, malfeasance, sustainability, dignity, etc.Sustaining a sound digital footprint in Nigeria requires sound structural inventiveness and widespread education by establishing deep technological AI accelerators or hubs across Nigeria. These accelerators will provide concentrated support and resources to high-potential AI startups, fostering research collaboration and accelerating commercialisation . Regular collaborations would yield useful information sharing and improve stakeholder involvement.

The government can also establish a partnership to confer and deliberate on the regulatory needs for a licence for Artificial Intelligence .AI regulation and monitoring to safeguard the integrity of individuals and corporations is an integral sustainability strategy to curb the bias against AI dependence. AI service providers should be licensed to ensure proper accountability when it comes to data usage. Adewuyi and Akindele posit that, "The increasing emergence of artificial intelligence-enabled technology ensures the need for a set of requirements to ensure only authorised businesses or service providers would offer Artificial Intelligence enabled services to the public.

This would not only ensure the safety and security of customer data but also serve as a monitoring mechanism to make sure only ethically and legally compliant Artificial Intelligence systems are deployed. It would also limit third-party use of the technology." Furthermore, the National Artificial Intelligence is of the view that a well-functioning and respected AI governance regulatory body provides clear guidance, enforces ethical standards, and promotes responsible AI development. Comprehensive risk management framework that minimises the potential negative impacts of AI deployment . The Nigerian Communications Commission can achieve this through its licensing department by establishing a new class of licence to be made available for Artificial Intelligence providers.

These licences would provide an avenue for regulatory examinations which would force the providers to guarantee security compliance .

Sam Anamoj (2024). *Ethical And Regulatory Framework of Artificial Intelligence (A.I) in Nigeria: The Dilemma Of Global Adaptation For Sustainable Growth.*

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Sam Anamoj (2024). *Ethical And Regulatory Framework of Artificial Intelligence (A.I) in Nigeria: The Dilemma Of Global Adaptation For Sustainable Growth.*:

Adewuyi, Roland & Adewuyi, Stella() Navigating the Ethical and Legal Terrains of AI Tool Deployment:

A Comparative Legal Analysis. *Communications of the IIMA*. Pg 140 - 157

For instance, In 2018, the Kenyan government established an eleven-member Blockchain and Artificial Intelligence task force comprised of experts from companies such as Safaricom, Cisco, IBM Research Africa, and the African Development Bank, as well as tech entrepreneurs and consultants from academia, research institutions and the local technology sector. The task force's aim was to propose a roadmap for contextualising the implementation of these new technologies in the context of overall public service delivery. The task committee was also obligated to offer suggestions on how the government may capitalise on developing technology over a period spanning five years, with other major milestones in 2027 and 2032 .

Also, discussions about making blockchain technology that aligned with the government's Big Four Agenda and the use of cryptocurrency to offer immediate, safe, cheap, and potentially semi-anonymous transactions were keenly made. From this observation, making an impactful footprint in AI and the digitised economy in Nigeria would have to include crucial innovations and a partnership that is enforced across all sectors, if an impact is to be made.

Therefore, Nigeria, in spite of the encumbrances against the proper implementation of AI codes of conduct must enact rules and stipulate laws that would match international standards and adequately position her for the unforeseen intricacies that could be experienced globally. This preparedness is crucial to sustaining the integrity of digitalisation and artificial intelligence across the facets of Nigeria's ecosystem: governance, business and finance, sports, defence and security, etc.

Ibid (n-67).
The Economist (May 6th, 2017). *The World's Most Valuable Resource is no Longer Oil, but Data.*
National Intelligence Strategy, August 2024 [Draft].

PART FIVE

Part Five:
Key Takeaways and Recommendations for Nigerian Businesses

ROME BUSINESS SCHOOL

Part Five: Key Takeaways and Recommendations for Nigerian Businesses

The findings presented in the foregoing parts of this paper reveal two central themes:

1. the future of digitalisation and Artificial Intelligence in Nigeria has had a fair start;

2. the expansion of digital technologies in Nigeria is imminent, although adoption may be gradual.

While several industries remain underresearched and undocumented, the majority which have been documented and examined signal the future immersion of sectors and business practices in digitalisation.

Furthermore, the dearth of research in some industries is not necessarily indicative of a lack of digitalisation and AI adoption in such industries; it only implies a lack of substantial data.

It is noteworthy, nevertheless, that digitalisation across the Nigerian business environment is industry-paced; in other words, industries are at their different degrees, or more contextually, tiers of digitalisation with some industries more advanced in digitalisation than others (see Table 1).

However, the business landscape is unpredictable due to economic, social, political, and international factors that may alter the rate or extent of digitalisation of each sector in the future.

So far, these factors have posed as either catalysts or barriers to digitalisation and AI in Nigeria. The driving factors have included the predominantly young population of the country, trade and commerce, and globalisation.

The challenges on the other hand include infrastructure deficits, skill gaps, cybersecurity concerns, ethical use of digital technologies, lack of government and stakeholder support, and poor policy and regulatory frameworks.

In general, the findings reveal the industry-wide opportunities in Nigeria, juxtaposed against the depth of work required to capitalise on the industries. This is especially because while the country has made visible progress, it still lags on a global scale.

Tier 1 represents industries which are experiencing digitalisation and AI adoption to a great extent. Unsurprisingly, both industries are responsible for banking and communications, hence the priority since they are heavy cross-continental relations.

Tier 2 industries are at the intermediate level with moderate levels of adoption and they include the healthcare and agriculture industries.

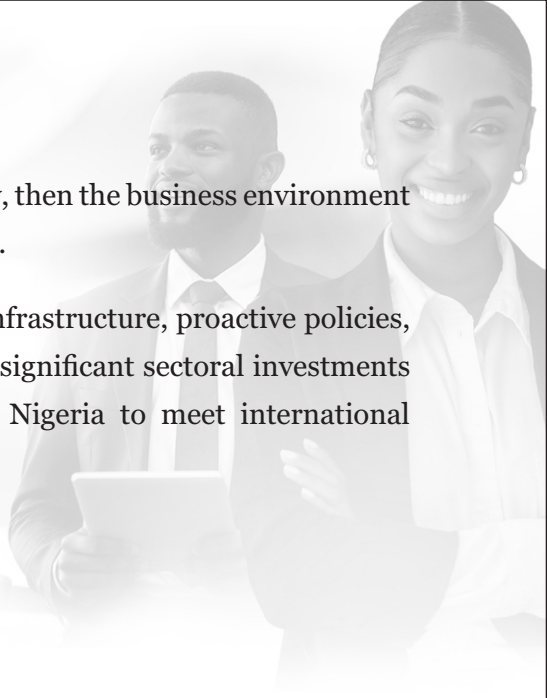
Tier 3 is the emerging level and represents a tier with windows for investment. This tier includes the oil and gas, manufacturing, education, and construction industries. Across all tiers, talent development is a uniform area for improvement.

Table 1: Industries and opportunities for investment

Industry	**Investment Focus**
Tier 1: High adoption and current investment priority	
Finance/Banking (Blockchain, AI in credit scoring and personalised banking)	Cybersecurity; Next-Gen banking; banking 4.0
Telecommunications (5G, wide-coverage broadband connectivity)	Expansion of broadband; 6G, edge computing

Rai Rahul & Murali Shruti (2020). Global Standards on Artificial Intelligence: A Report on Global Legislation and Policy Positions Governing AI Technology. Page 111
National Artificial Intelligence……..
Nigerian Communications Commission, (2020) "Ethical and Societal Impact of Artificial Intelligence (AI)" https://www.ncc.gov.ng(Accessed November 12, 2024).
NAtional Artificial Intelligence Strategy (2020) page 27

Tier 2: Moderate adoption and significant weighting	
Healthcare (Telemedicine, AI-powered service delivery)	Sensors; wearables; robotics; VR/AR; 3D printing
Agriculture (Moderate precision agriculture technologies)	Digital marketplace; precision agriculture solutions; farmer training
Tier 3: Emerging adoption requiring strategic investment	
Oil and gas (IoT for spill detection, pipeline monitoring, and safety)	AI and machine learning; talent development; edge computing; quantum computing; AR/VR; drones; blockchain
Manufacturing (Early-stage AI)	3D printing/additive manufacturing; Digital Twin; robotics; drones; predictive maintenance solutions
Education (Early-stage e-learning)	Learning Management Systems (LMS); ICT tools
Construction (Early-stage drones, IoT, BIM)	Digital Twin; 3D printing/additive manufacturing; robotics; drones; predictive maintenance technologies



If businesses intend to reap from the present and future digital economy, then the business environment needs to attain a level of readiness for the oncoming industrial revolution.

This will include addressing the challenges through standard digital infrastructure, proactive policies, digital literacy, and sensitisation to the grassroots. More strategically, significant sectoral investments are required to scale the existing level of digitalisation and AI in Nigeria to meet international counterparts.

Nigerian Communications Commission, (2020) "Ethical and Societal Impact of Artificial Intelligence (AI)" https://www.ncc.gov.ng (Retrieved November 11, 2024).
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Akindele & Adewuyi…… page 148-149

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Okoye, N.S., Uchenna, T.U. and Okechukwu, I.E., 2023. Addressing digital technology gap challenges: The Nigerian experience. *NG Journal of Social Development*, *11*(1), pp.95-100.

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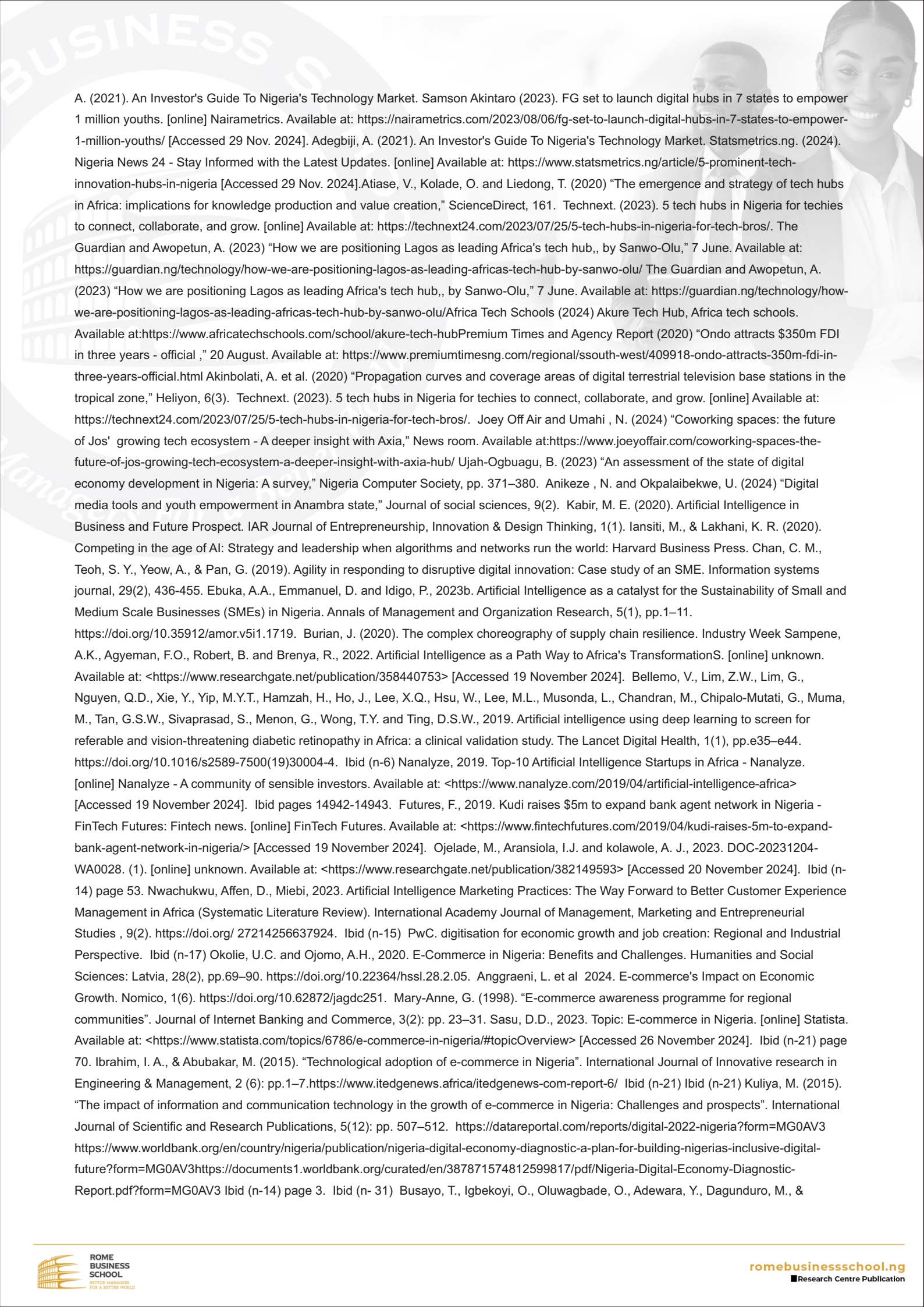

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www.romebusinessschool.ng
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+2349067556524