

REVIEW ARTICLE

Technology of the revolution four (4) and sustainable development goals in Nigeria

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Abstract

The paper examines the revolution's four (4) industrial technologies and sustainable development goals in Nigeria. An exploratory research method was adopted through the exploration of potential artificial intelligence, blockchain, and the Internet of Things (IoT) in enhancing public service delivery and sustainable development in Nigeria. Data were sourced from journals, articles, textbooks, government publications, and official documents. The paper reveals that the fourth industrial revolution's technologies have the potential to enhance effective public service delivery and sustainable development in Nigeria. It observes that the technologies may face some possible challenges, which include job displacement and the cost of adoption. The paper suggests that the government should, through artificial intelligence, ensure that citizens are rendered with effective service delivery. Also, the government should ensure the adoption of imminent technologies to strengthen service delivery and to transform rural communities into smart villages to reduce rural-urban migration.

Keywords: Fourth Industrial Revolution; Rural Dwellers; Service Delivery; Sustainable Development; Technologies

Introduction

The need for societal stability and sustainability has necessitated the sustainable development goals championed by the United Nations in 2015. More specifically, the socioeconomic needs encompass zero hunger, zero poverty, health, and employment. To this end, it is expected that every policymaker in a given society must ensure that the citizens receive sustainable services that will raise their standard of living. In pursuit of this goal, numerous policies have been implemented to effectively address various societal needs. Most developed countries believe that the technology of the fourth industrial revolution is the ideal solution to meet societal demands. As a result, the United States of America, the United Kingdom, Germany, the Republic of Ireland, and other countries have digitalised operation of the public to render services. According to Schwab (2016) and the World Economic Forum (2016), the absence of technology can render human activities ineffectual and fruitless. Fatile and Adejuwon (2018) are in agreement that technology be linked to the activities of man. They believe that the impending technology in service delivery has the potential to revolutionise government policies. However, government needs to ensure that it does not affect the activities of Manpower if development is to be sustainable

(Nalubega & Uwizeyimana, 2019). The World Economic Forum (2017) has therefore predicted that future technologies could lead to a worldwide decline in employment opportunities. It forecasted a total of five million job reductions. Nevertheless, Africans have the potential to experience socioeconomic growth if technology is fully adopted. Over the course of several decades, numerous African nations have faced challenges in providing essential services, combating poverty, addressing famine, and reducing inequality. The UN introduced a sustainable development vision in late 2014 to address these difficulties. This vision aims to prevent socio-economic underdevelopment by requiring states to achieve specific goals for a certain number of financial years. Nigeria, being the most populous country in Africa and the seventh in the world, behind Brazil according to World Population (2020) also possesses sufficient resources to meet its needs. Nigeria, as Africa's largest country, should lead the way in improving human capacity and achieving zero hunger and poverty. Recent reports show that, poverty, hunger, and inequality are Nigeria's most difficult problems. The World Poverty Index (2019) also indicated that Nigeria is the world's poverty capital. Fatile and Adejuwon (2017) argued that Nigerian policymakers have struggled to provide adequate services to mitigate this issue. Policymakers have found it challenging to deliver services that effectively reduce this threat. Ajulor (2018) also contends that the government lacks policy and programmes to enhance sustainable development through effective service delivery. It is important to note that the percentage of the poor residing in the rural areas outweighs the rich in urban areas of Nigeria. Estimates suggest that the majority of the impoverished in the country's remote areas are enduring extreme hardship, with government agencies rarely providing assistance. The inequality in distributing food and job opportunities among citizens has resulted in hunger, poverty, and unemployment, which remain challenges for public policymakers. One of the service delivery targets for sustainable development is to "alleviate hunger, poverty, and minimum unemployment" (Shava & Hofisi, 2017). The United Nations has reportedly created a series of programmes to address the three main issues (hunger, poverty, and unemployment) in order to meet the SDGs agenda. The majority of rural areas, characterised by poverty and hunger, have not received significant attention. Nigeria has conducted several studies on innovative technologies, public service delivery, and sustainable development. Among these studies is an article by Fatile, Olojede, and Adejuwon (2015), titled "Techno-bureaucratic governance and public service delivery: Indonesia and Nigeria in perspective." Nigeria in perspective. Their findings revealed that technology can enhance effective service delivery in Nigeria. In 2015, Fatile and Adejuwon published an article titled "Innovation and Service Delivery". Delivery in Nigeria: How Innovative In the 21st century, the field of information and communication technology, particularly advanced technologies, has experienced significant growth, and its popularity is rapidly increasing. The world of information and communication technology, particularly advanced technologies, has witnessed a drastic growth, and its popularity is increasing by leaps and bounds. "Bounds." Okafor, Fatile, and Ejalonibu (2014:49) assert that both citizens and businesses anticipate easy access to government services and information. According to their perspective, "many government agencies have traditionally functioned as separate business units, resulting in complex and disjointed communications that have led to inefficiencies and service ineffectiveness." These complex and disjointed communications have resulted in inefficiencies and service ineffectiveness. Francis and Okoye's (2018) study, "Repositioning Professionalism to Enhance Information Service Delivery for Sustainable Development Goals (SDGs)," focuses on the professional handling of information to enhance service delivery and align with the SDGs' vision in Nigeria. The SDGs movement in 2015 also focused on enhancing effective public service delivery in Nigeria, Africa, and the global community. Scholars have conducted numerous studies on the intersection of the fourth industrial revolution and service delivery. Since the emergence of the fourth industrial revolution, numerous studies have explored the relationship between 4IR and service delivery. Schwab, a contemporary at the World Economic Forum (2015), also links the technologies of the 4IR with societal affairs and human nature. The WEF (2016) asserted that connecting 4IR to service delivery can foster success. Other

scholars who have worked on service delivery and the 4IR in Africa include Moloji (2018); PSA (2019); Nalubega and Uwizeyimana (2019); Sharva and Hofisi (2017); Roberge (2017); and Desmond and John (2019). 2017); and Desmond and John (2019). Based on the foregoing, it is apparent that several studies have been conducted to suggest and recommend better approaches for policymakers to enhance poverty reduction in the nation. However, only a few previous studies have emphasized the importance of accurately obtaining technology to effectively engage with citizens in rural areas. To fill the existing literature gaps, the study examines the influence of Fourth Industrial Revolution (4IR) technologies, namely artificial intelligence (AI), the Internet of Things (IoT), and robotics, on the attainment of Sustainable Development Goals (SDGs) in Nigeria, particularly in relation to alleviating extreme poverty and hunger in rural regions.

Literature Review

The Fourth Industrial Revolution (4IR) has significantly impacted the Sustainable Development Goals (SDGs), particularly goals 1, 2, and 10. According to a recent report by the World Economic Forum (2022), the 4IR has created unprecedented opportunities to alleviate poverty through innovative solutions, enhancing financial inclusion and providing access to banking services for underserved populations. For instance, mobile money and digital payment systems have demonstrated significant success in this area (Manyika et al., 2022). Moreover, e-commerce platforms and digital marketplaces have created new income streams for entrepreneurs and small businesses (Huang et al., 2023). However, the 4IR also risks exacerbating poverty through job displacement due to automation and AI-driven efficiency gains, and widening income inequality (Ford, 2023). To mitigate this risk, policymakers must invest in digital skills training programs and online education platforms, equipping individuals with skills for better-paying jobs (OECD, 2022). In addressing Goal 2: Zero Hunger, the 4IR contributes significantly through precision agriculture enabled by IoT sensors, drones, and satellite imaging, optimizing crop yields and reducing waste (Shi et al., 2022). Digital platforms provide farmers with access to financing, markets, and expertise, while AI-powered agricultural analytics and predictive modeling enhance decision-making (Kamilaris et al., 2023). Regarding Goal 10: Reduced Inequalities, the 4IR can help bridge the digital divide through affordable connectivity and devices, enhancing access to education, healthcare, and financial services for marginalized groups (ITU, 2022). Digital literacy and skills development programs promote inclusive economic growth, while remote work and entrepreneurship opportunities facilitate social mobility (ILO, 2023). To harness the potential of the 4IR for SDGs, stakeholders must acknowledge both benefits and challenges. According to the United Nations (2024), responsible AI development and use are crucial in addressing algorithmic bias and reinforcing social and economic inequalities.

Conceptual Model

The model as shown in figure 1 was developed to show the relationship among the three key variables of the paper, that is, the fourth industrial revolution, service delivery and sustainable development. The key constructs as reflected in the research questions and objectives are also illustrated in the figure. The constructed model above shows how the fourth industrial revolution's technologies, which include high drones, artificial intelligence, high clouds, and robotics, influence service delivery towards the attainment of sustainable development goals in Nigeria. The integration of High Drone, Artificial Intelligence (AI), High Cloud, and Robotic technologies has transformative potential for service delivery, particularly in achieving Sustainable Development Goals (SDGs) 1, 2, and 10. High Drone technologies facilitate poverty reduction by monitoring poverty zones (Kumar et al., 2022), delivering aid and essential services (Irani et al., 2023), and enhancing disaster response (Sharma et al., 2022).

Artificial Intelligence (AI) enables predictive poverty mapping (Li et al., 2023), chatbots for financial inclusion (Chen et al., 2022), and personalized social services (Wang et al., 2024). In the context of SDG 2: Zero Hunger, High Drone technologies enhance agriculture through precision monitoring and optimization (Kamilaris et al., 2023) and crop health analysis and yield prediction (Shi et al., 2022). Artificial Intelligence (AI) enables predictive analytics for crop yields (Ford, 2023) and AI-powered farming decision-making tools (Huang et al., 2022). High Cloud provides data analytics for agricultural productivity (John Deere, 2022) and cloud-based farm management systems (Granular, 2023).

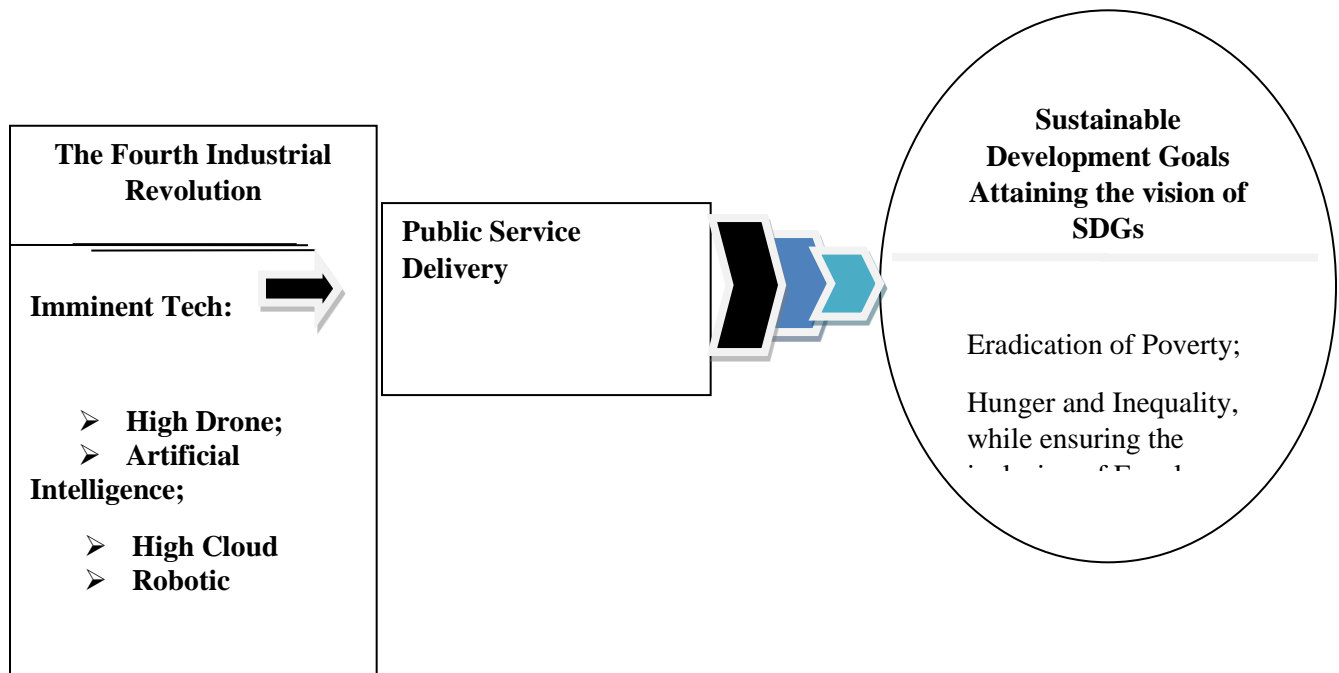


Figure 1: Technological-cum-Service Delivery Model

Source: Quantitative Service Delivery Model in Salihah & Salihu, (2012), modified by the Author

Regarding SDG 10: Reduced Inequalities, High Drone technologies promote inclusivity by monitoring and responding to natural disasters (Irani et al., 2023) and delivering essential services to marginalized communities (Kumar et al., 2022). Artificial Intelligence (AI) enables bias-detection and mitigation in decision-making (Bellamy et al., 2023) and personalized education and skill development (Wang et al., 2024). High Cloud provides secure data storage for marginalized communities (IBM, 2022) and cloud-based platforms for social inclusion (Microsoft, 2023). Robotic technologies offer automated food distribution systems (Kim et al., 2023), assistive robots for people with disabilities (Lee et al., 2022), and automated healthcare and medical delivery systems (Kim et al., 2023). Effective integration of these technologies requires careful consideration of ethical implications, infrastructure development, and capacity building.

Theoretical Framework

According to Fatile and Adejuwon (2018:28), most scholars use the Technological, Organisational, and Environmental (TOE) theory as the sole theoretical framework for investigating advanced technologies. However, scholars have developed several other theories and models to explain and address the issues in technologies and service delivery. These theories include the Service Innovation Theory, the Fourth Industrial Revolution Theory, the Technological, Organisational, and Environmental (TEO) Theory, the Substantive Theory, the SERVQUAL Model, and the Delone and Mclean IS Success Model, among others. These theories hold merit in their unique objectives. However, they were unable to clarify the connection between technological innovation and the promotion of sustainable development goals through service delivery. This study adopted, among others, the 4IR theory of technology and the Technological, Organisational, and Environmental (TOE) theory.

The Fourth Industrial Revolution Theory

Professor Schwab, a prominent author and the chairman of the World Economic Forum (2016), champions the Fourth Industrial Revolution Theory, a concept that some German institutes had already proposed prior to the emergence of the World Conference on the Economy. Their efforts were in concomitance with the innovation of Smart Factory in June 2005. The German government-powered research institute launched 4IR in 2006 (Moon & Seol, 2017). Schwab explains that different nations' nature and environments make service delivery difficult over time. He argued that without innovation, service delivery will remain problematic. Innovation in the method of service delivery is necessary to achieve greater results. Schwab further argues that ineffectiveness is like a man, and corruption sets in in the process of providing services to societies (Shava & Hofisi, 2017). However, his assertion was criticized for 'subjecting man to technologies' by conspiracist theorists, who argue that Schwab's assertion is biased and tends to exaggerate technologies over man. Conspiracists further argue that Schwab overlooked the potential socio-economic consequences of technology taking control of human affairs. However, Schwab asserts that technologies require experts who possess a strong technological drive to function. Schwab goes on to clarify that the technologies will only encourage individuals, organizations, and governments to enhance their competencies through technological development. Finally, he noted that the government will record timely, effective, and efficient service delivery if it adopts technologies as an alternative (Kravchenko & Kravchenko, 2019). This paper adopts this theory, as it provides a clear explanation of the significance of new technologies in human societies and how they aid governments worldwide in providing essential services to their citizens.

Technological, Organisational, and Environmental (TOE) Theory

From 1950 to the early 1960s, the Technological, Organisational, and Environmental (TOE) theory gained widespread popularity. The theory was led by Harold, Albert, and other contemporaries. Since its implementation at the Institute of Tavistock, the experiment has gained global recognition (Fatile & Adejuwon, 2017: 197). The theory also draws on a large body of theoretical and experiential information about an organization's work design and operation (Abdelnour-Nocera, 2005). Scholars have recently grouped technological organization and environment (TOE) theory to evaluate empirical facts about the existence of technological innovation (Fatile & Adejuwon, 2018: 27). DiPietro proposed the TOE theoretical framework in the 1990s, and since then, scholars have used it to explain ICT innovation between the organization and its environment (Oliveira & Martins, 2011). According to the TOE theoretical framework (Fatile & Adejuwon, 2018: 27), technology can support government policies and programs as well as the societies it represents through the three elements of technological, organizational, and environmental. However, it has faced criticism due to its inherent bias in disregarding the

economic aspect. The theory falls short in elucidating how an organization or nation can adapt technology to its economic circumstances. However, this paper adopted this theory because it was able to explain how an organization or government relates to its environment, i.e., society, in meeting environmental demands.

The relevance of theories on 4IR and SDGs

The relevance of these theories to SDGs lies in their potential to enhance service delivery, particularly in rural-remote areas. 4IR technologies can serve as an alternative for delivering effective services, while the TOE theory provides a framework for understanding the organizational and environmental context. By integrating these theories, researchers can develop strategies to harness technological innovation for sustainable development. These theories address the research gap by clarifying the connection between technological innovation and SDGs through service delivery. They offer a nuanced understanding of the complex relationships between technology, organization, environment, and society, ultimately contributing to more effective and sustainable service delivery. The 4IR theory and TOE theory provide valuable insights for policymakers, practitioners, and researchers seeking to leverage technological innovation for SDGs. By embracing these frameworks, stakeholders can develop context-specific solutions, enhance service delivery, and promote sustainable development.

Methodology

For this exploratory study, we employed a thematic analysis approach to synthesise insights from secondary sources. Our analysis involved: i. Source selection: We systematically searched academic databases (e.g., Google Scholar, Web of Science) and reputable online sources (e.g., World Economic Forum, United Nations) using specific keywords related to the Fourth Industrial Revolution, sustainable development goals, and service delivery. ii. Data extraction: Relevant information was extracted from selected sources, focusing on key themes, concepts, and findings. iii. Theme identification: Through iterative analysis, we identified and refined key themes related to the research questions.

Discussion and analyses

Sustainable Development Goals as Strategies to Alleviate Poverty, Hunger, and Inequality

During the United Nations movement in 2015, practitioners, experts, and world leaders made significant strides to establish significant watersheds for sustainable development. This was done to align with the vision of reducing poverty, hunger, inequality, environmental degradation, and other issues, with the aim of achieving inclusive societies (Sustainable Development Agenda, 2017). The expiration of the MDGs sparked this movement. Environmental factors encapsulated the challenges and led to the creation of 17 SDGs, among others. The world has viewed sustainable development goals in various ways (Maduabum, 2008; Ajulor, 2018: 1498). Thomas and Anthony (2005) describe sustainable development as “the ability to transform development into sustainability to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.” Abubakar (2017) views sustainable development as a driving force behind development and policy visions. Abubakar uses it as a tool to establish a connection between the present and the future. Sustainable development is a paradigm that improves livelihood without causing deforestation (Benaim & Raftis, 2008; Browning & Rigolon, 2019; Mensah, 2019). Evers (2017) contends that sustainable development is a strategy for engendering human development goals.

This paper, therefore, deduces that SDGs are a succession of the MDGs to ensure development sustainability in the world, based on different definitions of SDGs. The SDGs boast 17 goals, surpassing those of the MDGs. Many global issues have highlighted the importance of these goals. Other objectives of this paper include achieving zero poverty, zero hunger, and zero inequality. The table below illustrates the goals of sustainable development:

Table 1: Goals, Visions and the indications of the 17 Sustainable Development Goals

S/N	Goals	Vision	Indications
1.	No poverty	End abject poverty	Reach out to all individuals living in poverty
2.	Zero Hunger	End Hunger	Reach out hungry people with the provision of food items
3.	Good health and wellbeing	Fight mentally disorder and maternal/mortality rate	Ensure everyone has health coverage and access to safe and effective medicines and vaccines.
4.	Quality Education	Universal Standard education up to the age of 24	Availability of funds for such categories
5.	Gender Equality	End inequality in the world	Gender equality, human right, and a peaceful, prosperous world.
6.	Clean Water	Protect the world from unhygienic/disease water	Clean water protects people from disease, yet three in 10 people lack access to it.
7.	Clean Energy	Sustainable electricity for all people irrespective of the position.	Targets for 2030 include using more renewable, affordable energy.
8.	Economic Growth	Maintain economic growth for a substantive period	The aim is for sustainable economic growth and decent employment for all.
9.	Industry and Infrastructure	Promote industries and infrastructure in every nation	This involves building a resilient infrastructure and fostering innovation.
10.	No Inequality	Everyone with equal opportunity	The poorest 40 per cent of the population should be able to grow their income faster than average.
11.	Sustainability	Good stands in all ramification for a longer period	The UN wants to increase affordable housing and make settlements inclusive, safe and sustainable.
12.	Responsible Consumption	Reduce wastage through the help of recycling. Waste to wealth initiative.	This goal aims to foster eco-friendly production, reduce waste and boost recycling.
13.	Climate Action	Increase energy capacity to regulate the climate	Urgent action is needed, by regulating emissions and promoting renewable energy.
14.	Life Underwater	Optimally utilizing the resources from the oceans	The aim is to conserve and sustainably use the oceans, seas and marine resources.
15.	Life on Land	Employing an expert to regulate the ecosystem to stop the degradation	To stop degradation, we must preserve forest, desert and mountain ecosystems.
16.	Peace and Justice	Educating the citizens and orientating the public on natural justice	The aim is inclusive societies with strong institutions that provide justice for all.
17.	Partnership	Partnering with sectors and third sectors economy to develop nations.	If all countries are to achieve the goals, international cooperation is vital.

Sources: Ajulor, (2018:1504); <https://www.sightsavers.org/policy-and-advocacy/global-goals/>

The sustainable development goals provide guidance on how to achieve their mission. However, in the course of this paper, only three of the sustainable development goals are adopted based on the objectives of this paper, which include, among others: 1st No Poverty; 2nd Zero Hunger; and 10th No Inequality. This paper, therefore, evaluates the fourth industrial revolution's technologies, such as the AL, high drone, robots, and high cloud, and their influences on service delivery towards the attainment of sustainable development goals in Nigeria. This paper put forward the imminent of AI technologies and its effect on the initiative of the Nigerian policymakers in designing a mission-driven service delivery to the people and the rural dwellers in Nigeria.

The below table discuss those three goals:

Table 2: Specified Sustainable Development Goals based on the Objectives of the Paper

Goal	Items	Nigeria's Experience
1 st	No Poverty	Poverty has been a challenge in Nigeria and policymakers have found difficulty to curb despite enormous poverty alleviation programs created to end the menace. The dream of the United Nation is centered on how this menace can be curbed or reduced drastically in the world. The government on the other has lots to do to end poverty through alternative means.
2 nd	Zero Hunger	Hunger in Nigeria is more pronounced among people living in remote areas of Nigeria. Such categories of people do not normally have access to government food programs. This is one of the visions of the United Nation to End; the government also must ensure the proper plan is available to achieve the vision.
10 th	No Inequality	It has been a recurring phenomenon that inequality remains one of the issues that have not been sorted Nigeria. Unequal access to government programs like job opportunities and other benefits. it has then been argued that most of the poor are not considered in many of the government's job opportunities.

Source: Developed by the Author.

The United Nations targets 17 goals for sustainable development, including No Poverty, Zero Hunger, and No Inequality, which this paper addresses. According to the paper's objectives, policymakers in Nigeria have encountered challenges in addressing these three categories. The delivery of services to achieve these goals has also been stalled, as reports continue to confirm that poverty and inequality in job opportunities remain major concerns in Nigeria. Thus, this paper examines the role of the imminent AI, drone, robots, and cloud technologies of the fourth industrial revolution. Will it improve service delivery and provide a solution to Nigeria's long-standing problems?

The Fourth Industrial Revolution's impact on Sustainable Development Goals in Nigeria

The fourth industrial revolution is an era that introduces the world to imminent and sophisticated technologies. The technologies, according to Naude (2017), are capable of changing the world economy and political apparatus. The existing technologies, such as artificial intelligence, robotics, automobiles, and 3D printing, are becoming increasingly integrated into human affairs, and it seems that societies are gradually losing their innovation. Schwab (2016) posits that the 4IR technologies hold great promise for Africa, as they can comprehensively

address the complex societal demands (Shava & Hofisi, 2017). Kaplan (2015) clarifies that the debate over whether 4IR is an abstract concept or a tangible reality has reached a resolution. According to him, Schwab's technologies can maintain sustainable service delivery. Many developed nations have used drones and robots to support societal services, and the results have been impressive. This means that Africa's hope is becoming a reality in this technological age.

The Fourth Industrial Revolution's Technologies and Rural Dwellers in Nigeria

The 4IR's emerging technologies could potentially serve as substitutes for public service delivery. One of the new technologies promoted by 4IR, the drone, has been used worldwide to locate, detect, and provide accurate information about a state of affairs. Security agencies have also utilized the drone to apprehend criminals. Many nations have also utilized it to conduct precise citizen censuses, even in their rural areas. In Nigeria, the government limits its opportunities and programs to a select few notable citizens, excluding some remote dwellers, and a proper census is necessary to determine the total population. The drone could function as a tool to provide precise data on rural-remote areas, enabling the inclusion of these residents in poverty alleviation policies and programs that align with sustainable development objectives (Nalubega & Uwizeyimana, 2019: 4). Additionally, artificial intelligence (AI) can assist the government, policymakers, and agencies in crafting effective policies that will positively impact the lives of citizens. AI is a technological base that is programmed to think and suggest possible solutions for the operating master. Nigeria has faced challenges in crafting compelling policies, particularly those addressing societal needs; AI's design aims to provide assistance in this area (Moloi, 2018: 2).

Technologies, Food Security, and Sustainable Development Goals in Nigeria

To reduce hunger among the rural-remote dwellers, the government needs to ensure food security since several rural-remote areas are involved in agriculture. Technologies will support modern machines to cultivate effective and timely crops for rural dwellers. In this regard, technology plays a crucial role by providing the government with information about areas that are too remote for them to visit. Additionally, the government's provision of food security and its role as a 'means to an end' for rural-remote areas of the nation will alleviate poverty, thereby advancing sustainable development goals. On the other hand, the government can generate income through the end product and taxation from these residents, thereby promoting both national development and sustainable development goals (Shava & Hofisi, 2017: 205).

The Fourth Industrial Revolution, Job Opportunities, and Poverty Alleviation Programs in Nigeria

The world is evolving into a global technological community, where human societies are embracing transformative innovation. The likes of AI, robots, drones, automobiles, 3D printing, clouds, and so on are arguably hopes for governments in the world (Shava & Hofisi, 2017). Schwab (2016) explains that the imminent technologies are relevant in any field and have been designed to support service delivery. WEF (2016) argues that gross job displacement will negatively affect socio-economic development in the world. According to WEF (2016), the estimated 5 million jobs may be a loss if 4IR fully takes momentum. Schwab then clarified that technological innovation will create more job opportunities. WEF further clarified that the technologies will not promote a lack of computer skills among people. The WEF will force people to enhance their knowledge and abilities as a prerequisite for employment. With the nature of service delivery in Nigeria, how will the 4IR

influence job opportunities in Nigeria, given the nature of service delivery? The 4IR's technologies provide information to the government and its assistants, enabling them to identify vulnerable individuals who may not benefit from government jobs or poverty alleviation programs. It will also function as a modern, digitalized machine, utilizing technological tools to facilitate effective cultivation and alleviate stress. Only the government's ability to accurately estimate the population and engage with citizens in rural, remote areas can achieve this. The 4IR technologies can transform rural areas into smart villages, enabling residents to access information and communication about developmental projects. 4IR can play a crucial role in achieving the dream for government and society as a whole.

The Challenges of the 4IR's Technologies in Achieving Sustainable Public Service Delivery in Nigeria

The 4IR technologies are not without flaws. Therefore, scholars have argued that the forthcoming technologies seem unattainable for Africa. WEF (2017) also criticised the 4IR for appearing to displace jobs globally. Apart from that, there exist some notable challenges that can serve as hindrances to the successful implementation of 4IR technologies in Nigeria. It is instructive to note that most of the technologies can only be run through 'Big Data', such as 5G internet, which requires installation in rural communities to serve as a server for testing. However, such materials are unavailable, and service delivery in this manner may be hard to enhance. Nigeria, as a nation, grapples with the challenge of technological deficiency, potentially complicating the government's adoption of new technologies. Again, the nature of the Nigerian government ministries may negate the adoption of technologies. Consider the 3IR technologies, introduced a few years ago, which encompass information and communication technology (ICT). Several government ministries encountered challenges in integrating ICT into their operations. Additionally, the fear of losing jobs due to technological advancements has stifled interest in adopting new technologies. Given the current state of the nation, where the unemployment rate poses a significant challenge, the adoption of the Fourth Industrial Revolution (4IR) could potentially exacerbate the situation. The cost of adopting 4IR's drones and robots to complement service delivery is high and may be challenging for the government. Social amenities such as food security, health, and education are part of service delivery. However, some public officials are reaping significant financial benefits from this. There is a lack of adequate data to ascertain the number of citizens benefiting from government policies and programs. This has left rural dwellers at a disadvantage. Such public officials will do everything possible to ensure that the government does not employ the modern technologies that the 4IR revolution has brought. If they don't propose a solution, the challenges mentioned above could further stall the dream of sustainable development.

Conclusion

This study examined the effect of the fourth industrial revolution on service delivery and sustainable development in Nigeria. This study asserts that, despite potential obstacles to technology adoption, emerging innovative technologies present a viable alternative for service delivery in Nigeria. The neglect of many communities in Nigeria is a result of the corruption and self-centeredness of some political elites; this compounded the problem of hunger and poverty in the affected communities. Nigeria has failed to achieve the United Nations' vision of sustainable development goals, which include "no poverty, zero hunger, and equality." Therefore, this paper proposes the utilization of innovative technologies to accurately determine the nation's population and identify remote areas where the government can provide effective services, thereby achieving the sustainable development vision in Nigeria. This paper made the following suggestions:

To ensure effective service delivery, the government must first ensure the adoption of the 4IR's technologies. Drones and artificial intelligence can break the bridge between rural dwellers and the government. Rural people can now channel their demands to the government. Foreign experts should train the government and its officials on how to use technologies to provide services to the people. The government must also guarantee the transformation of rural areas into smart villages, integrating technology into human activities to curb the migration from rural to urban areas. Secondly, the government should spend more on socio-economic development, technologies, and food security so that people in rural areas can be free from abject poverty. This could potentially contribute to achieving the sustainable development vision. Technologies will aid in regulating the issue of corruption and the diversion of various items. Lastly, since 2006, when Nigeria conducted its census, the population has been estimated. The government will utilize artificial intelligence and drones to identify every individual in Nigeria. Through this initiative, the government will ensure that everyone has access to job and food opportunities. This will lead to a decrease in unemployment and poverty rates in Nigeria, thereby optimizing the achievement of the country's sustainable development goals.

Declaration

This research was conducted in accordance with the principles of academic integrity and objectivity.

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References

- Abubakar, I. R. (2017). Access to sanitation facilities among Nigerian households: Determinants and sustainability implications. *College of Architecture and Planning, University of Dammam, Saudi Arabia Sustainability*, 9(4), 547.
- Afegbua, S.I. (2017). Globalization and the New Public Sector Management. In Maduabum, C.P. & Akhakpe, I.B., *The Dynamics of Public Sector Management: a Reader*. John Archers Publisher
- Ajulor, O.V. (2018). The Challenges of Policy Implementation in Africa and Sustainable Development Goals. *PEOPLE: International Journal of Social Sciences*, 3(3), 1497-1518
- Ajulor O. V. (2015). A policy analysis model of participation and change management. *Journal of, Creativity and Innovations for Sustainable Development, Research and Development Institute*, 15 (2), 31-38.
- Akhakpe, I.B. (2014). *Bureaucracy and Good Governance*. Primark Nigeria Limited, Educational Publishers

- Bellamy, R., Kulkarni, A., & Li, Y. (2023). AI fairness 360: An extensible open-source library. *IBM Journal of Research and Development*, 67(2), 1-9. doi: 10.1147/JR.2023.100401
- Benaim, C. A. & Raftis, L. (2008). *The Social Dimension of Sustainable Development: Guidance and Application: Thesis submitted for completion of Master of Strategic Leadership towards Sustainability*, Blekinge Institute of Technology, Karlskrona, Sweden
- Browning, M., & Rigolon, A. (2019). School green space and its impact on academic performance: A systematic literature review. *International Journal of Environmental Research and Public Health*, 16(3), 429.
- Cerin, P. (2006). Bringing economic opportunity into line with environmental influence: A discussion on the Coase theorem and the Porter and van der Linde hypothesis. *Ecological Economics*, 5(6): 209–225.
- Chen, Y., Zhang, J., & Liu, B. (2022). Chatbots for financial inclusion: A systematic review. *Journal of Financial Technology*, 1(1), 1-20. doi: 10.1007/s43594-022-00011-5
- DePietro, R., Wiarda, E. & Fleischer, M. (1990). The context for change: Organization, technology, and environment. In L.G. Tornatzky & M. Fleischer (eds). *Processes of technological innovation*. Lexington, MA: Lexington Books.
- Fatile, J.O., Olojede, I. & Adejuwon, K. (2015). Techno-bureaucratic governance and public service delivery: Indonesia and Nigeria in perspectives. *Africa's Public Service Delivery and Performance Review* 3(3):149-176. Available from: https://www.researchgate.net/publication/312667836_Techno-Bureaucratic_Governance_and_Public_Service_Delivery_Indonesia_and_Nigeria_in_Perspectives [accessed Oct 17 2020].
- Fatile, J. O., & Adejuwon, K. D. (2017). Innovation and Public Service Delivery: how Innovative is Nigerian Bureaucracy? *International Journal of entrepreneurial Development, Education and Science Research*, 4(2): 193-218.
- Fatile, J. O., & Adejuwon, K. D. (2018). Governance in the digital era: An assessment of the effectiveness of big data on emergency management in Lagos State, Nigeria. *OIDA International Journal of Sustainable Development*. 11(10): 25-36 Available from: https://www.researchgate.net/publication/329277423_Governance_in_the_Digital_Era_An_Assessment_of_the_Effectiveness_of_Big_Data_on_Emergency_Management_in_Lagos_State_Nigeria [accessed Oct 17 2020]
- Ford, M. (2023). *The rise of the robots: Technology and the threat of a jobless future*. Basic Books.
- Gossling-Goidsmit, J. (2018). *Sustainable development goals and uncertainty visualization. A thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Cartography*.
- Granular. (2023). *Cloud-based farm management*. Retrieved from <https://www.granular.ag/cloud-based-farm-management>
- Huang, X., Wang, Y., & Li, Y. (2022). AI-powered farming decision-making: A review. *Computers and Electronics in Agriculture*, 197, 105783. doi: 10.1016/j.compag.2022.105783
- IBM. (2022). *Cloud computing for social services*. Retrieved from <https://www.ibm.com/cloud/social-services>
- Irani, P., Sampaio, P. R., & Santos, R. (2023). Drone-based disaster response: A systematic review. *Journal of Humanitarian Logistics and Supply Chain Management*, 13(1), 2-15. doi: 10.1108/JHLSCM-02-2022-0013
- John Deere. (2022). *Data analytics for agricultural productivity*. Retrieved from <https://www.deere.com/en/data-analytics-agricultural-productivity>
- Kamilaris, A., Fonts, A., & Prenafeta, J. (2023). Precision agriculture monitoring using drones and IoT sensors. *Computers and Electronics in Agriculture*, 205, 106433. doi: 10.1016/j.compag.2023.106433

- Kaplan, J. (2015). *Humans Need Not Apply: A Guide to Wealth and Work in the Age of Artificial Intelligence*. New Haven: Yale University Press, 256 pp.
- Kaga, U. Maser., C.& Reichenbach, M. (2011). Sustainable development: principles, frameworks, and case studies. *International Journal of Sustainability in Higher Education*,12(2),
- Kravchenko, A. &Kyzymenko, I. (2019). The fourth industrial revolution: a new paradigm of social development or posthumanist manifesto. *Philosophy and Cosmology*, 22(1): 120-128.
- Kim, J., Lee, S., & Kim, B. (2023). Automated food distribution systems: A review. *Journal of Food Science*, 88(2), 538-545. doi: 10.1111/1750-3841.15411
- Kumar, A., Singh, P. K., & Kumar, P. (2022). Drone-based poverty monitoring: A systematic review. *Journal of Economic Development*, 44(2), 1-15.
- Lee, S., Kim, J., & Lee, J. (2022). Assistive robots for people with disabilities: A systematic review. *Journal of Rehabilitation Research and Development*, 59(4), 531-544. doi: 10.1682/JRRD.2021.02.0045
- Li, Y., Zhang, Y., & Li, X. (2023). Predictive poverty mapping using machine learning algorithms. *Journal of Economic and Social Measurement*, 47(1), 1-12. doi: 10.3233/JEM-220012
- Manda, M.I. &Dhaou, S.B. (2019). Responding to the challenges and opportunities in the 4th Industrial revolution in developing countries. *Proceedings of the 12th International Conference on Theory and Practice Electronic Governance (ICEGOV2019)*, Melbourne, VIC, Australia. <https://doi.org/10.1145/3326365.3326398>
- Manyika, J., Chui, M., Bisson, P., Woetzel, J., & Stolyar, K. (2022). *The economic potential of artificial intelligence in South East Asia*. McKinsey Global Institute.
- Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: A literature review. *Journal of cogent Social Sciences*, 5(1)
- Microsoft. (2023). *Cloud-based platforms for social inclusion*. Retrieved from <https://www.microsoft.com/en-us/cloud-social-inclusion>
- Moloi, D. (2018). The fourth industrial revolution and the future of government. *Service Delivery Review*, 11(3)
- Moon, Y. &Seol, S.S. (2017). Evaluation of the theory of the 4th industrial revolution. *Asian Journal of Innovation and Policy*, 6(3):245-261
- Myers, J. (2016). *What new jobs will exist in 2035?* World Economic Forum, Davos, February 29;
- Nalubega, T. &Uwizeyimana, D.E., (2019). ‘Public sector monitoring and evaluation in the Fourth Industrial Revolution: Implications for Africa’, *Africa’s Public Service Delivery and Performance Review* 7(1), [HTTPS:// doi.org/10.4102/apsdpr.v7i1.318](https://doi.org/10.4102/apsdpr.v7i1.318)
- Naudé, W. (2017). *Entrepreneurship, Education and the Fourth Industrial Revolution in Africa*. IZA – Institute of Labor Economics
- Okafor, C., Fatile, J.O. &Ejalonibu, L. (2014). Public Service innovations and changing ethos in Africa. *Africa’s Public Service Delivery and Performance Review* 2(4):46-71. [accessed Oct 17 2020]
- Oliveira, T. & Martins, M. F. (2011) Literature review of information and communications technology adoption models at the firm level. *The Electronic Journal Information Systems Evaluation*, 14(1), 110-121.
- Peter, G.B & Pierre, J. (2018). *The Next Public Administration: debates & Dilemmas*. SAGE Publications Limited, London
- PSA, (2019). *The era of the fourth industrial revolution: challenges and opportunities for public service*. The PSA the union of choice www.PSA.co.za

- Shava, E. & Hofisi, C. (2017). Challenges and opportunities for public administration in the fourth industrial revolution. Department of Public Management and Administration School of Basic Sciences North-West University
- Schwab, K. (2016). The Fourth Industrial Revolution: The World Economic Forum. <http://www.weforum.org/pages/the-fourth-industrial-revolution-by-klaus-schwab>
- Sharma, A., Kumar, A., & Singh, P. K. (2022). Drone-based disaster response: A systematic review. *Journal of Disaster Research*, 17(4), 549-562.
- Shi, X., Wang, Y., & Li, Y. (2022). Precision agriculture monitoring using IoT sensors and drones. *Journal of Intelligent Information Systems*, 69(2), 257-271. doi: 10.1007/s10844-021-00667-9
- United Nations Development Programme. (2022). Using drones for social good. Retrieved from <https://www.undp.org/content/undp/en/home/2030-agenda-for-sustainable-development/drones-for-social-good>
- Wang, Y., Li, Y., & Zhang, Y. (2024). Personalized education and skill development using AI-powered chatbots. *Journal of Educational Technology Development and Exchange*, 15(1), 1-15.
- Worldometer (2020). World population. <https://www.worldometers.info/world-population/>
- World Economic Forum, (2019). Civil Society in the Fourth Industrial Revolution: preparation and response. www.weforum.org
- World Economic Forum, (2016). Five million jobs by 2020: the real challenge of the fourth industrial revolution. <https://www.weforum.org/press/2016/01/five-million-jobs-by-2020-the-realchallenge->
- World Economic Forum, (2016). The future of jobs: Employment, skills and workforce strategy for the fourth industrial revolution. <https://www.weforum.org/reports/the-future-of-jobs>
- Xing, B., Marwala, L. & Marwala, T., (2018). Adopt fast, adapt quickly: Adaptive approaches in the South African context (Chapter 8), in N.W. Gleason (ed.), *Higher education in the era of the Fourth Industrial Revolution*, pp. 171–206, Macmillan, Singapore.
- Xing, B. & Marwala, T., (2017) Implications of the fourth industrial age for higher education, *The Thinker*. <http://www.thethinker.co.za/resources/73%20xing%20and%20marwala.pdf>.
- Zhai, T. T. & Chang, Y. C. (2019). Standing of environmental public-interest litigants in China: Evolution, obstacles and solutions. *Journal of Environmental Law*, 30 (3): 369–397