A Review of Issues and Challenges of Digital Transformation and Sustainable Development in Nigeria

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Abstract
Digital technology plays an essential role in driving change, especially in developing nations like Nigeria. Its recent surge globally, including in Nigeria, has profoundly impacted various facets of society, such as economies, governments, and civil societies. This transformation, characterized by its speed and profound consequences, necessitates a comprehensive understanding and intentional, inclusive design to ensure equitable participation. This transformation is crucial for achieving the United Nations Sustainable Development Goals (UNSDGs). In Nigeria, digital transformation can reduce emissions through energy efficiency, the adoption low-emission technologies, and the creation of new market opportunities. However, it raises sustainability concerns such as the use of rare material, inequalities in technology access, and employment opportunities. It intersects with global environmental challenges like climate change, waste management and environmental pollution. The aim of this study is to review issues and challenges hindering digital transformation in achieving multiple SDGs, focusing on Nigeria. This study made use of secondary data and adopted content analysis by reviewing existing literature to ascertain the interaction between digital transformation and sustainable development. Findings highlight digital technology's transformative potential in economies, governance, and the environment, aiding emission reduction and creating market opportunities. The study recommends strategic digital frameworks prioritizing inclusivity and sustainability to reshape Nigeria's approach to achieving the UNSDGs.

Keywords: Digital Transformation, Sustainable Development and Digital Technology

Introduction

the future is digital and digital, technology is fundamental for change in any country. digital technology has become an empowering force for good or a sower of more division and exclusion will depend on the choices we make today. These choices hold the power to influence the future of our world. The rapid development of technological landscape has made digital transformation (DT) an essential driver for organizational growth and success (Kraus et. al., 2021). According to Rosário et al., (2022), "the drive towards digital transformation has made the sustainable adoption of innovative digital technologies imperative for firms seeking to stay competitive and meet changing customer expectations." The concept of continuous digital transformation involves responsibly and durably integrating digital technologies into business processes while considering their environmental, social, and economic impacts. In order for enterprises to successfully implement these cutting-edge digital technologies, they must carefully assess how they affect the environment, maximize energy efficiency, and reduce

electronic waste. It also entails tackling the social implications of technology use, including privacy issues, maintaining inclusion, and encouraging digital literacy in staff members and clients. Organizations can achieve operational efficiencies and cost savings as well as make a positive impact on society by lowering their carbon footprint, promoting social development, and stimulating economic growth by adopting sustainable practices while using cutting-edge digital technologies (George et al., 2021).

Rapid technological innovations present organizations with new problems and opportunities in today's highly competitive economy. According to Tohãnean et al., (2020), he stated that "One important tactic that companies are using to navigate this environment is digital transformation (DT)." Digital transformation is the process of incorporating digital technologies into every facet of business operations, transforming the way businesses provide value to their customers and maintain their competitive advantage in the market. DT has become essential for companies to survive and grow in this age of perpetual innovation and disruption (Hanelt et. al., 2021). Businesses can build greater ties with their customers by using DT to better understand them and interact with them in a more personalized way. Additionally, it opens up new revenue generating channels like digital markets and e-commerce platforms. Furthermore, employees are empowered by digital transformation, it gives them access to tools and technology that improve teamwork and stimulate creativity (Attaran, 2020).

Recently, African leaders formulated Agenda 2063, which aims to improve the standard of living, health, and overall well-being of African people by promoting education and skill development, with a strong foundation in science and digital technology (Fomunyam, 2020). These initiatives are yielding positive, as several African countries have used digital technology to digitalize their economies, increase financial inclusion, trade accessibility, and public service delivery, all of which have sped up sustainable development. They have also extended vital services to underprivileged populations. For instance, M-Pesa and Flutterwave have revolutionized the banking and financial sector in Africa, these companies provide excellent transaction services that support sustainable development, financial inclusivity, business activity, and help enterprises avoid the harmful effects of the COVID-19 pandemic (AfDB, 2021). Similarly, by offering healthcare services in both urban and rural locations, mPedigree has assisted in closing the gap between the rich and the poor. Furthermore, the use of industry 4.0 technologies has improved productivity across the continent postitioning Africa for sustainable development and equitable growth.

In Nigeria, governments, corporations, institutions of higher learning, agencies, and enterprises are utilizing digital technologies to build economic resilience, reach underserved groups, and accomplish shared objectives of inclusive growth and sustainable development. Industry 4.0 technologies have been used in a variety of economic sectors, most notably agriculture, e-commerce, education, finance, industry, waste, energy, and transportation, to respond and adapt to gradual changes as well as abrupt disruptions. These technologies include disruptive technologies, big data analytics, cloud computing, cyber-physical systems, internet of things (IoT), blockchain, artificial intelligence (AI), drone technology, autonomous machines, and simulation. For instance, Uber, OPay, and Lara Transport used digital technology to

revolutionize the transportation industry, while Jumia and Konga digitalized the Nigerian trading system (Ajahm & Chigozie-Okwum, 2019). Additionally, Piggyvest, a digital financial platform, has contributed to increasing people's access to banking and financial services in Nigeria and is centered on making saving accessible. Similar to how Zoom and Ulesson have improved the education sector, several agrotech firms have advanced the agricultural industry by utilizing cloud data solutions. For instance, Uber, OPay, and Lara Transport used digital technology to revolutionize the transportation industry, while Jumia and Konga digitalized the Nigerian trading system. Additionally, Piggyvest, a digital financial platform, has contributed to increasing people's access to banking and financial services in Nigeria and is centered on making saving accessible. On the other hand, Nigeria's construction industry has advanced thanks to the application of industry 4.0 technologies like prefabrication and building information modeling (BIM), (Adepoju & Aigbavboa, 2020). Activities on online sharing platforms, like online banking, online healthcare, online shopping, online training, and online schooling, have increased. In Nigeria, when the pandemic struck in 2019 and 2020, the Outbreak Response Management and Analysis System (SORMAS), an open-source mobile e-health platform, helped nearly triple the country's healthcare coverage (Exemplars in Global Health, 2020). The COVID-19 epidemic has reportedly made it necessary for Nigeria to step up efforts in the development and adoption of digital technologies in order to strengthen national capabilities and foster economic growth.

Digital Transformation and Digital Technologies

Digital transformation is the integration of digital technologies into all areas of business, fundamentally changing how economic and social activities are conducted to improve efficiency and create new opportunities. Digital transformation will mean and require different things depending on the business for some, it can mean how you change business processes, for others, it’s about the change in customer relations (Bleicher & Stanley, 2017). What’s important is that digital transformation goes beyond merely modifying process.

Digital technology refers to electronic devices, tools and systems that generate, store and process data in digital form, using binary code e.g, computers, mobile devices, internet, videos, apps, and so others. It enables rapid processing, transmission and storage of information facilitating tasks like; communication, information retrieval, data analysis, automation and others. As a transformational force, digital technology has changed many elements of our lives and the way organizations function. Digital technology is the cornerstone of organizational innovation and change within the context of digital transformation. Businesses can develop new value propositions, optimize resource allocation, and streamline operations with its help. Organizations may gather and evaluate enormous volumes of data utilizing digital tools and platforms, facilitating data-driven decision-making and customer-specific experiences (Du & Shen et. al., 2023). Additionally, digital technology makes collaborative and flexible workflows possible, dismantling conventional boundaries and empowering businesses to quickly adjust to changing market needs. It has the power to transform consumer interaction, propel operational excellence, and upend business paradigms. Businesses that successfully

integrate digital technology into their digital transformation process will be well-positioned to prosper in the digital age.

United Nations Sustainable Development Goals

One of the most crucial aspects of achieving the United Nations Sustainable Development Goals (SDGs) is the sustainable adoption of innovative digital technologies in digital transformation. The 17 SDGs are global objectives designed to address pressing social, economic, and environmental challenges that will establish a sustainable future for all people (Diala & Amodu, 2023, Sarkis & Ibrahim, 2020). A number of the SDGs are directly related to the topic of the sustainable adoption of innovative digital technologies in digital transformation, The Goal 9 of the 17 SDGs relates to the development of innovation, inclusive and sustainable industrialization, and resilient infrastructure. It highlights the significance of developing digital technologies to shoot economic growth, improve productivity, and support sustainable industrial practices. Goal 7 of SDGs main objective is to ensure that everyone has access to modern, affordable, dependable, and sustainable energy while Goal 12 is ensuring sustainable consumption and production patterns (Sarkis & Ibrahim, 2020). Organizations can support the UNSDGs and promote good change in businesses in building, energy, industry, waste management, healthcare, education, and agriculture by adopting innovative digital technologies in a sustainable manner during the digital transformation process.

Sustainability and Digital Transformation

The interrelation between sustainability and digital transformation (DT) at the corporate level was reviewed by Gomez and Gonzalez in 2022 (Han et al. 2022). The research also reviewed other published studies using extensive content analysis filters. DT is viewed as both a catalyst and a precondition for reaching sustainability. Hence, it is suggested that, in order for businesses to survive the digital revolution, there is need to improve their digital competencies and balance the economic, environmental, and social implications. The more the use of ICTs in industrial production, the greater are the potential and threats they pose for environmental sustainability, as well as the political will to address these issues. In 2020, Kunkel and Matthess assessed the industrial and digital strategies of four Sub-Saharan African nations, three East Asian and Pacific Island countries, and four countries considering the implications of ICTs on professions for environmental constants (Lian et al., 2022). According to the report, regulations prioritize a wide range of vague expectations and give more weight to the advantages of using information and communication technologies.

Thus, the purpose of this study was to review how digital transformation contributes to Nigeria's sustainable development. The report, in particular, review industry 4.0 technologies that have been implemented in several Nigerian industries and describes how these technologies are being leveraged to effectively address issues of inequality, economic deterioration, and sustainable development. The study also shows how Nigeria could lessen the effects of climate change by utilizing digital technologies. This study is distinctive in that it focuses on integrating sustainability concepts into the digital transformation process. This report acknowledges that although DT can give businesses a competitive edge and increase

efficiency, it's crucial to think about long-term sustainability results and potential issues that could hinder the use of digital technologies achieving Sustainable development in Nigeria.

Digital Economy Policy/Strategy of Industry 4.0 Adoption in Nigeria

The formal establishment of the National Information Technology Development Agency (NITDA) Act of 2007 by the National Assembly gave the agency the authority to plan, develop, and promote the use of information technology in Nigeria. This was one of the many steps the Nigerian government took to digitalize the country's economy (Ndalu et al., 2022). The National Broadband Plan has also been established by the Nigerian government. Among other policy strategy taken by government are the digitization of important processes like the use of the Bank Verification Number (BVN), online meetings and conferences, the Treasury Single Account (TSA) and the Integrated Payroll and Personnel Information System (IPPIS), SIM registration, and the National Identity Number (NIN) data registration exercise (Federal Ministry of Communications and Digital Economy, 2020).

Recently, Nigeria's Minister of Communications, Innovation and Digital Economy, Bosun Tijani announced plans to train three million Nigerians with technical skills over the next four years in the Nigeria Sets Sights on Drastic Digital Transformation. Recently, Project Ecosystem Steering Committee was also inaugurated to guide the strategic direction of the Nigeria Digital ID4D Project in order to secure a verifiable digital identity for every Nigeria, thereby enhancing service delivery, governance and creating opportunities for growth in the digital economy. This will help increase the number of persons with a National Identification Number, issued by robust and inclusive foundational identification (ID) system that facilitates their access to services. (Akintaro, 2024). The government has been able to save costs, combat corruption, and follow the path of sustainable development as a result of digitizing important activities, notably Biometric Verification Number (BVN), virtual conferences and meetings, and Treasury Single Account (TSA). It has also improved the level of citizen participation in important activities (Ifijeh et al, 2016, Moemeke, 2019). The Federal Ministry of Communications was recently reorganized by the Nigerian government to become the Federal Ministry of Communications and Digital Economy. Its new mandate is to create and carry out efficient digital economic policies and plans that will accelerate the country's economic digitalization. Because of the growth of industry and developments in technology, the world has experienced many changes over the years. These days, the main factors driving the phenomena called digital transformation are markets instability, unpredictability, complexity, and uncertainty.

Digital Transformation towards Actualization of United Nations Sustainable Development Goals in Nigeria

Because of the growth of industry and developments in technology, the world has experienced many changes over the years. More than half of the world's population was online, in 2019, according United Nations, (2021) digitalization indicators; a significant digital divide was seen between industrialized and developing nations. While 85% of people in Europe and North America had access to the internet, just 20% of people in the least developed nations which

Nigeria belong were online, meaning that those people were not able to benefit from the digitalization of society.

According to United Nations Economic and Social Council, (2021), the penetration rate of industrialized nations was high, with over 33 subscribers per 100 inhabitants; in poorer nations, such as Nigeria, the figure was just 11.5 per 100 residents with only 1.3 subscriptions per 100 people, fixed networks are virtually absent in the least developed. The United Nations Secretary General's on "Our Common Agenda" report, which was adopted by the General Assembly in 2021 following the COVID-19 pandemic, includes 12 commitments, including climate protection and digital cooperation. These are expected to be discussed at the 26th Conference of the Parties to the UN Framework Convention on Climate Change in 2021, in addition to the Paris Agreement (United Nations, 2021).

Digital transformation in relation to the green transition of climate change mitigation through agriculture, forestry, and other land use (AFOLU) like building, energy, industry, transport, and waste management, digital technologies can significantly contribute to the United Nations Sustainable Development Goals (UNSDGs) being fulfilled. This will also quicken the transition towards sustainable development. Digitization in addition, could close significant data gaps in the Sustainable Development Goals (SDGs) monitoring process, which balances the three main aspects of sustainable development; economic, social, and environmental that are interwoven and indivisible (United Nations, 2023).

Agriculture

The advent of industry 4.0 technology has played a significant role in the recent development of agricultural sector. The agriculture industry in Nigeria has seen a transformation through the application of digital technologies, including artificial intelligence (AI), like; the Internet of Things (IoT), blockchain, drone technology, and cloud data solutions, among others. For example, BeatDrone maps farmlands, collects vital agrodata, and monitors and eradicates crop mortality using drone technology. Drone technologies are used to spray herbicides and insecticides to eradicate weeds and vermin, respectively. Also, farmers may assess the temperature of their farmland and decide when to irrigate it with the aid of the thermal drone. Furthermore, drone technology gathers data on a farm's chlorophyll levels using data pooling and artificial intelligence (AI) tools like near-infrared devices. This information enables farmers to assess the health of their crops, take the appropriate preventative measures or treatments, preserve crop lives, and boost agricultural harvests. Farmers can strengthen their defenses against any threats with the use of these technologies (Raithatha, 2021).

Furthermore, Nigeria's agricultural industry has performed better through the application of the blockchain, IoT, and AI technology. For example, Thrive Agric, Hello Tractor, Farmcrowdy, Crop2Cash, TradeBuza, Verdant AgriTech, AFEX, and AgroMall have all made significant contributions to the development of Nigeria's agricultural sector. Hello Tractor is an IoT digital solutions platform that links Nigerian farmers with financial institutions, dealers, and owners of farm equipment, particularly tractor owners. With the use of this Internet of Things (IoT) platform, poor farmers who depend on outdated farming methods and have limited financial

resources, which frequently lead to under-cultivation and delayed planting can enhance their farming practices, increase their income and production. By bringing together tractor owners and small, low-income farmers who frequently use conventional farming techniques to increase farm yields, Hello Tractor fosters inclusivity. The digital solutions company in particular, supports financial inclusion by facilitating farmers' access to financial resources by putting them in touch with financial institutions. Additionally, the platform uses AI and data pooling to gather information on farmers' actions and offers remote tracking of farm equipment to guard against fraud, loss, and misuse of machinery. This helps farmers and tractor owners develop resilience. These encourage sustainable development, particularly in Nigeria with regard to sustainable farming and good labour. In addition to digitalizing agricultural practices in Nigeria, a few other technology-driven businesses have partially promoted sustainable development and inclusive economic growth. Farmcrowdy, Thrive Agric, AgroMall, Crop2Cash, and Afex are a few of these (Raithatha, 2021).

Similarly, the agricultural industry has mostly employed digital platforms like Zoom and YouTube to increase flexibility against worldwide pandemics that may occur like COVID-19, which required social distancing and reducing conversational communication costs. The primary purpose of the two platforms has been to instruct Nigerian large and small holder farmers in innovative farming methods. They have also been a channel for disseminating important information and keeping farmers informed about digital marketing tactics that will increase their revenue. Social media sites like Facebook and Twitter have also helped agri-business by giving agricultural marketers an effective way to connect with producers of agricultural inputs and consumers of farm products and get them to do business. In conclusion, digital technologies facilitate sustainable development and encourage inclusion by linking smallscale farmers to the global market.

Energy

Digitalization in the energy sector facilitates consumer interaction, data availability, and network control. Digitalization offers sustainable options and improve energy efficiency. Digital app-based energy management techniques can contribute to highly accurate supply and demand assesments, which may result in more sustainably produced and consumed energy. During process optimization, the intelligent use of datasets may potentially result in positive energy savings of up to 20%. (Mondejar et al., 2021 & The Royal Society, 2020). For example, solar energy has been the main target for the clean energy transition. Using accurate and free satellite images, a machine learning model based on spatial patterns has been created to map the utility scale of solar energy plants. Through digital payments like e-wallets, the economy and society have already benefited greatly from the development of digital technology in other areas. Because of the energy usage of numerous digital services, including social networking, online gaming, messaging, video streaming, and online shopping, there are enormous opportunities to reduce greenhouse gas emissions (Husaini & Lean 2022). Numerous digitization strategies have been applied to renewable energy and energy savings. While other algorithms, such natural computing, are utilized to address multi-objective problems or produce optimal model parameters, machine learning methods are widely used for forecasting.

Additionally, these forecasting and optimization models might be included into fuzzy logic systems, which would be helpful as instruments for decision support (Nishant et al., 2020).

Health

The health sector is essential to every economy, as a country's healthcare facilities have a direct impact on its citizens' quality of life. The Nigerian digital health system is obviously still in its infancy and in desperate need of care (Ajadi et al., 2021). A few hospitals in Nigeria have adpted data pooling and AI to monitor and diagnose medical conditions as well as handle daily tasks like billing and record-keeping. Mairabot and mobile health information tools were created in response to the COVID-19 epidemic in Nigeria in order to combat the virus and inform Nigerians about its symptoms, routes of transmission, and preventative measures. During COVID-19, Nigerians were also informed about the status of the pandemic, including the number of confirmed cases, deaths, recovered cases, and new cases in the nation, via a digital network like Whatsapp (WHO, 2021). Moreover, almost 98% of Nigerians are helped by the digital translation of COVID-19 symptoms, precautions, and advice into multiple languages in addition to strengthening the nation against the COVID-19 pandemic and encourages inclusivity. A handful of health start-ups have digitalized the operations of the Nigerian health sector: GeroCare, InStrat Global Health Solutions, LifeBank, AirBank, Omoni, Find-a-med, GenRx 54gene, WellaHealth, Otrac, and Truppr. For example, GeroCare, a cloud-based primary healthcare center in Nigeria, treats senior patients in the comfort of their own homes while leveraging blockchain and IoT to build resilience against attacks on the aging population and to promote inclusivity.

Blockchain, IoT, and artificial intelligence (AI) were some of the digital technologies that InStrat Global Health Solutions used to alter and enhance the provision of healthcare in Nigeria. When COVID-19 spread over the world in 2020, InStrat developed and released the Android COVID-19 App, which allowed them to provide Nigerian health professionals with correct information on the pandemic. This helped to strengthen resilience against the epidemic. In Nigeria, the application assists more than 20,000 front-line healthcare providers in recognizing, evaluating, and handling possible cases (InStrat. 2021). By utilizing satellite technology like Inmarsat and NigComSat, InStrat encourages inclusivity in the health industry. Additionally, the company made use of digital technologies to create the Clinical Administration Kit, an electronic health data management system that is efficient and effective and helps health workers in rural and urban areas gather patient medical histories and treatment options, then distributes them via available satellite or mobile internet networks. This helps the health facilities in Nigeria become more resilient to both internal and external threats. Furthermore, LifeBank uses digital technology to create a blood system powered by blockchain that allows medical professionals and patients to access blood and review the safety records of blood and blood products. Other examples are AirBank, which uses innovative technology to deliver emergency medical oxygen; Omoni, which provides parents with digital tools to monitor their children's health; and Otrac, which gives medical professionals access to relevant training and courses via an online learning platform to improve their clinical performance and knowledge (Ajadi & Drury, 2021).

Financial Sector

The financial sector worldwide depends heavily on digital technologies, including artificial intelligence (AI), the Internet of Things (IoT), blockchain, cloud computing, big data analytics, and robotics. These are some of the popular digital technologies utilized in the financial sector (Binder et al., 2019). Over the past several years the banking services industry in Nigeria has changed due to the emergence of financial technology businesses, or FinTech companies. Digital technologies like blockchain, WhatsApp, chatbots, point of sale (POS) terminals, peer-to-peer lending platforms, digital banking, mobile lending and savings, and crowd-funding have revolutionized the operations of the Nigerian financial system (Omisakin, 2021 & Abdulquadri et al., 2021). These developments have maintained the nation's course toward sustainable development while also assisting the industry in strengthening its resistance against any pandemic like COVID-19. Furthermore, digital technologies foster the delivery of financial services in rural areas, where a greater proportion of the population lacks access to banking, hence enhancing financial inclusion. Additionally, the implementation of disruptive technologies facilitates the onboarding of new consumers, creates digital databases for identification, and facilitates loan availability for small and medium-sized businesses (SMEs). Fintech companies have digitalized financial services in Nigeria. Some of these companies are Carbon, Paylater, Quickteller, Bench, Renmoney, Fairmoney, Piggyvest, and Cowrywise. These online financial marketplaces have not only enhanced financial inclusion but facilitated more SMEs' access to loans in Nigeria (Binder, 2019).

Education

Digital technologies have altered how education sector operates on a global scale. Particularly in underdeveloped nations, programs that would have otherwise denied education to kids are now available to them thanks to digital and distance learning. However, the use of digital technologies is still at a low level in Nigeria. This could be as a result of some factors, including inadequate funding of educational sector, lack of expertise, resistance to change on the part of the educational sector, over reliance on government support for educational institutions and lack of coordination between various initiatives to enhance digital learning (Nwachukwu et al., 2021).

Nigeria ranked 79th out of 81 nations in 2018 with a digital readiness score of 2.125, according to a report by the Economist Intelligence Unit Limited that assesses a country's capacity to use information and communication technology to support a digital learning environment (The Economist Intelligence Unit Limited, 2018). This merely indicates that digital learning method is not being adopted quickly by Nigerian educational sector. There are still few noteworthy initiatives underway in the nation to support digital learning environment, despite educational sector's digital backwardness. For example, the most well-known distance learning institution in Nigeria, the National Open University Nigeria (NOUN), is altering the way Nigerian universities operate. In contrast to traditional institutions, NOUN uses a combination of Web-based modules, audio, videotapes, and textual materials to virtually give lectures. Students who otherwise would not have been able to attend school in Nigeria can now do so (Mac-Ikemenjima, 2005). Additionally, digital learning makes the institution more resilient

especially in the event, like COVID-19 pandemic. A digital education startup called uLesson used digital technologies to develop a virtual learning environment for pupils, primarily Nigerian elementary and secondary school children, in response to the issues presented during COVID-19 pandemic. This has had a significant impact on how primary and secondary school children in the nation learn and prepare for exams, as well as strengthening their defenses against both internal and external threats that could interfere with their academic work. The joint admission and matriculation board's (JAMB) introduction of computer-based exams has advanced the use of digital technology in Nigerian education, and major universities are currently using these techniques.

Transportation

Digital companies are posing a severe threat to the established procedures in Nigeria's transportation industry. For instance, e-transport businesses like Nairaxi, Uber, OPay, Lara. Transport and Kobo360 depend on technology to digitize transportation services in Nigeria, enhancing inclusivity, encouraging resilience to shocks, and putting the country on the path of sustainable development. For example, Nairaxi has developed a multi-service platform and digital payment system that enable users to buy taxi services at a reasonable price by leveraging disruptive technologies like blockchain, artificial intelligence (AI), and the Internet of Things (IoT). Additionally, the digital platform offers a function that lets users purchase from the comfort of their homes, track orders, and have groceries and other products delivered. Uber, Taxify, and OPay are some of the companies in the transportation industry that provide comparable services (Gerretsen, 2020).

However, in Lagos State, Nigeria, people's mobility has been made easier by the AI chatbot Lara Transport. Essential information is supplied by this chatbot, including detailed instructions, estimated fares, and other ways to get from one location to another. Additionally, Kobo360 is a digital transportation company that has revolutionized Nigerian transportation services. Kobo360 uses big data and additional technologies to create a strong logistic platform that resolves logistical issues and lowers supply chain transportation expenses. By linking truck owners, drivers, cargo recipients, and cargo owners, the logistic platform facilitates the creation of an equitable, sustainable, and effective supply chain. More specifically, the company helps manufacturers gain market share and lowers agricultural waste, which increases farmers' income (Gerretsen, 2020). Kobo360 became well-known during the COVID-19 pandemic because it contributed to the development of resilience to the virus at a time when the Nigerian government was implementing various steps to stop the virus from spread.

Industry

In the global e-commerce business, digital technologies continue to be the engine of sustainable development; in Nigeria, e-commerce sector is possibly the most digitalized. Disruptive technologies are being employed in Africa to remove trade barriers and stabilize the commercial system. Digital businesses like Jumia, Konga, Mall for Africa, Olx, and Jiji have drastically altered the rules for both customers and marketers. Rather than requiring sellers to advertise their products, they enable buyers to place orders and have their purchases delivered stress-free, swiftly, and affordably (Dibb et al., 2012). These e-commerce companies played a

major role in facilitating trade during the COVID-19 epidemic, which contributed to the resiliency of the e-commerce sector. By offering their services to underprivileged communities in order to encourage sustainable development in Nigeria, the platforms help foster inclusivity.

Waste

The yield of agricultural products could be increased can mechanical and digital applications, which could result in an increase in revenue. Avoiding GHG emissions from food loss and waste could counterbalance the application of fuel and power. Reducing food waste with the aid of information technology helps lower energy use and greenhouse gas emissions. (Hamma et al., 2022 & Fayustov, 2020).

Benefits of Digital Transformation for Sustainable Development

Improved efficiency: Through the elimination of unnecessary steps and decrease in human error, automation and digitization convert manual processes into effective digital systems. These improves worker productivity and streamlines processes. For instance, automated production lines reduce waste and save energy compared to conventional techniques. Digitizing files reduces duplication, expedites data processing and retrieval, and saves paper. By cutting down on resource waste, this operational efficiency lowers expenses and promotes sustainability objectives, resulting in an eco-friendly corporate model.

Data-driven decisions: Massive volumes of data are processed via data analytics to find patterns. From an ecological perspective, it can identify problems that consume resources or produce waste. It can identify energy-inefficient hardware or processes and draw attention to patterns in energy use. By addressing the identified inefficiencies, waste can be reduced, operational effectiveness can be increased, and resource conservation can be encouraged. Businesses may make sustainable, well-informed decisions that benefit both the company and the environment with the aid of this data-driven strategy.

Remote work: With the help of digital transformation and tools like cloud computing and video conferencing, remote work is made possible, eliminating daily journeys and cutting carbon emissions. Businesses can further reduce greenhouse gas emissions by using less energy to heat, light, and chill their offices when there are less people working there. Allowing employees to work from home not only improves convenience and flexibility but also lessens environmental effect and helps to mitigate climate change.

Reduction in paper usage: Controlling every step of a supply chain is not easy. Blockchain and other digital technologies promote sustainable practices within companies by enabling real-time tracking and data insights across supply chains. These tools ensure transparency by verifying the suppliers' responsible environmental and working conditions practices. This reinforces accountability and helps businesses uphold their environmental sustainable goal (ESG) commitment.

Supply chain transparency: It is difficult to oversee each link in a supply chain, through real-time tracking and data insights across supply chains, blockchain and other digital technologies

encourage sustainable practices within businesses. By confirming the suppliers' conscientious handling of the environment and labor circumstances, these technologies guarantee transparency. This strengthens accountability and aids companies in keeping their promise to the Environmentally Sustainable Goals (ESG).

Lower physical footprint: Companies can use digitalization to hold virtual training sessions and meetings, which will cut down on the requirement for travel and physical space and, eventually, carbon emissions. Additionally, this lowers the cost of logistics, office utilities, and transportation. One example is digital learning systems that are available anytime, anyplace. Also, digitalization processes increases flexibility at work, supports environmental efforts and increases operational efficiency.

Digital products/services: Businesses can dramatically lower their carbon footprint by using digital alternatives to reduce resource consumption. One way publishers can reduce costs and carbon emissions is by switching to eBooks, which eliminates the energy, material, and waste associated with the creation and delivery of physical books. Accessibility, customer convenience, and environmental sustainability are all improved by this digital transition.

E-Waste Management: While it's great that offices are going paperless, what about e-waste? The annual production of e-waste worldwide is 50 million tons. With platforms that connect companies with recyclers, lifecycle monitoring systems, and AI-powered separation tools, digital transformation technologies efficiently manage e-waste. Enhancing sustainability, promoting a circular economy, improving component recovery for reuse or recycling, lowering environmental pollution, and encouraging responsible disposal of electronic devices are all gains made from this.

Sustainable Innovation: Digital technologies foster innovative sustainability solutions. For example, Artificial Intelligence (AI) and machine learning analyze data for sustainable strategies, while IoT tools optimize energy usage. Blockchain promotes eco-friendly supply chain transparency, and emerging technologies facilitate carbon capture. These digital innovations help businesses meet environmental sustainable goals (ESG) targets, create greener products and services, and contribute to global environmental goals.

Challenges Digital Transformation for Sustainable Development

Despite its benefits and opportunities in digitalization, it presents significant challenges. There are growing concerns about their negative impacts on the environment, society, and economy about the energy demand and consumption when running facilities like data centers, which are the backbone of the data-driven digital economy. Thus, it is necessary to assess the potential challenges that characterize the digital economy in sustainability to develop a more sustainable and responsible approach and promote innovation, growth, and sustainability

Job Displacement and Insecurity: Automation and digital technology are developing quickly, transforming the labour market and raising the possibility of job losses. Robots and automation technologies are taking the place of labourers in the manufacturing and agricultural sectors, which previously relied mostly on manual labor. These changes have a significant

effect on individuals, communities, and the environment while worsening already-existing inequities. Furthermore, there is growing concern about the possibility of a skills gap, as workers might not have the abilities needed to adjust to new technology and the shifting nature of the labour market. Employees now find it difficult to keep up with the necessary skills to take advantage of the opportunities presented by the constant developments. This mismatch between workers' abilities and those in demand has resulted in underemployment and unemployment. Job loss has a detrimental effect on people's well-being and quality of life, which may make it more difficult to achieve sustainable development.

Market Monopolies and Concentration of Power: Concerns over the effects of market monopolies and power concentration are intensifying as businesses enter foreign markets. Due to their access to highly qualified individuals and digital technologies and platforms, the majority of large firms are able to expand and gain dominance across multiple sectors. The power of the business to suppress competition, hinder innovation, and limit customer choice is frequently linked to its dominance, which has a detrimental effect on the sustainability of the economy, society, and environment. Monopolies decrease incentives for sustainable behaviors and restrict the variety of goods and services that consumers can choose from. Furthermore, they might abuse or misuse their position of authority through dishonest commercial dealings, shady algorithms, or data breaches. Because there is little competition as a result of the concentration of power, companies can participate in immoral and unsustainable business activities without worrying about facing backlash because customers have few options for substitute goods and services. This problem impacts both the environment and society, as shown by problems like worker exploitation and personal data misuse.

E-Waste and Pollution: There are serious threats to human health and the environment from the rapid innovation and introduction of new technical gadgets with short life cycles and rapid undesirability, which lead to an increase in e-waste. The majority of countries lack the infrastructure and resources necessary to properly dispose of e-waste, which worsens the issue of improper e-waste management systems. It is usual practice to find non-sustainable alternatives, such illegally exporting e-waste to underdeveloped nations or disposing of it in landfills. Significantly, the majority of electronic waste is both biodegradable and toxic. The most common disposal techniques are open-air burning and acid baths, which remove valuable materials from electronic waste. Toxic components released into the environment include lead, mercury, polybrominated flame retardants, lithium, barium, cadmium, and mercury. These pollutants can have a serious negative impact on the health of the communities surrounding the affected areas. In order to tackle these obstacles, it is imperative to foster sustainability throughout the electronic device life cycle. This can be achieved by employing recyclable and more sustainable materials, prolonging the lifespan of gadgets, and encouraging recycling and reuse. Businesses and customers need to be made aware of the need of sustainable business operations and responsible disposal.

Energy Consumption and Carbon Emissions: Greenhouse gas emissions (GHG) are as a result of the extensive energy and natural resource use of digital technologies, which include servers, devices, and networks. Technology manufacturers are creating and utilizing more electronic devices that require significant energy inputs to facilitate activities such as

extracting and processing raw materials, manufacturing and transporting devices, and so on, as the demand for high-performance devices and data-intensive applications continues to grow. A major issue facing the digital economy is the rising energy consumption and carbon emissions brought on by the growing usage of media streaming, cloud-based services, and other data-intensive applications. Promoting efficiency at every stage of the digital technology life cycle from manufacture to disposal is necessary to meet this challenge. This entails utilizing infrastructure, resources, and technologies that are more sustainable and efficient. Reducing the carbon footprint of digital technology also requires switching to a low-carbon economy and using renewable energy sources.

Inequality and the Digital Divide: While the goal of digital technology is to provide everyone with greater access to knowledge, opportunities, and information, it is also marked by significant inequality and the digital divide, which continues to deny many people access to technology and information globally, particularly those who live in poor, rural, or marginalized places. It is imperative to acknowledge that equitable access to technology and information, together with digital inclusion, necessitate investments in infrastructure, enhanced internet connectivity and digital literacy, and the production of accessible material available in several languages and formats.

Privacy and Ethical Data Protection: Digital technology has the potential to seriously affect security, privacy, and human rights violations, which could jeopardize sustainability initiatives. Excessive use of AI and personal data can lead to discrimination against and exclusion of particular groups, as well as inequality. Large volumes of personal data are collected, processed, and shared by most businesses using digital information and communication technologies. This raises privacy and data protection concerns because it may result in the sale of personal data to third parties, data breaches, or access to people's personal information. The adoption of sustainable practices is eventually impacted by these problems since they erode people's confidence in digital technologies. Therefore, in order to achieve sustainability, ethics and responsibility in digital technology must be fostered. This includes implementing ethical norms and practices in the development and use of technology as well as respecting human rights and privacy while handling data.

Initial Investment: Adopting digital green technologies necessitates making strategic investment decisions in light of the rapidly evolving technology. For small firms with tight funds and possible skill gaps, this can be quite difficult. To effectively leverage digital transformation and sustainability, it is imperative for these companies to identify and implement cost-effective and expandable solutions.

Digital Literacy and Inclusion: The transition to sustainability and the fourth industrial revolution means that you need to be encouraging digital literacy among your employees and clients. Inequalities in digital proficiency can jeopardize customer happiness, market reach, staff morale, and operational effectiveness. Preventing global inequities requires promoting inclusivity and digital literacy. It use basic language, simplifies sentences, and arranges data logically.

Complexity: It can be challenging to integrate eco-friendly practices with digital transformation. It involves complex measurements that have to take social, economic, and environmental factors into account. Other difficulties include making sure international partners follow sustainability guidelines and developing a corporate culture that is open to changes brought about by technology. Furthermore, the rapid advancement of technology demands constant investment, learning, and adaptation. To overcome this obstacle, support and communication with your teams are crucial.

Conclusion

In order to help Nigeria achieve its sustainable development goals, this study reviews the issues and challenges of innovative digital technologies and transforming them into effective digital transformations. The study showed that aligning DT goals with SDGs improves long-term sustainability outcomes for various sectors of the economy, including energy, finance, waste management, transportation, agriculture, and health. These sectors primarily rely on digital technologies to foster inclusivity, foster resilience, and support sustainable development in Nigeria. The study found that adopting digital technologies with a sustainability focus gives businesses a competitive edge and enhances effective governance through better resource allocation, stakeholder engagement, and risk reduction for successful implementation and results that promote sustainability. In order to achieve sustainability goals in Nigeria, the study suggests that creative digital technologies be implemented with strong integration, change management techniques, and stakeholder involvement. In an effort to reduce the potential impact of upcoming internal and foreign shocks on the Nigerian economy, the report also highlights the importance of stakeholder participation in fostering effective DT and addresses the barriers preventing Nigeria from adopting industry 4.0 technologies. In addition, the government needs to create plans to stop the exodus of skilled workers and create laws that would support the establishment of digital businesses in Nigeria. The last step is for the government and business executives to design a system of incentives that would support digital technologies for sustainable development in Nigeria.

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