# HARNESSING AND LEVERAGING THE CONVERGENCE OF AI, 5G, AND BIG DATA ANALYTICS TECHNOLOGIES AND INNOVATIONS FOR SUSTAINABLE DEVELOPMENT: LITERATURE REVIEW

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**Abstract**

The power of converging and coupling Artificial Intelligence (AI), Fifth Generation Cellular(5G), Internet of Things (IoT), Big Data analytics, and Cyber-security has been touted to be the next revolutionary technologies. If applied correctly, the synergy of the aforementioned technologies is poised to unravel, transform and yield unparalleled economic efficiency and productivity globally across various sectors. It is important to note that each of these technologies has an enormous impact as a standalone in various industries/sectors but when properly combined, the technologies will create an array of opportunities that hugely impact widely all sectors of global economy. This paper will carry out a systematic review of applications of the above-mentioned technologies towards improving Africa's multi-sectoral economy, and their global impact. The findings of this paper will guide the development of techniques of converging various technologies towards enhancing efficiency and impacting sustainability in virtually all sectors of human endeavors.

**Keywords**

AI, IoT, BGB, Big data analytics, Cyber security.

## 1. Introduction

Attainment of sustainable development goals (SDGs) is the agenda of great focus in interim milestones by 2030. The world in 2050 (TWI2050) has set aside goals for evaluation of the attainment and implementation of SDGs at all social and industrial sectors as advocated in SDG 17 (partnership and integration), which is aimed to address the full spectrum of the transformational challenges related to achievement of the 17 SDGs in an integrated manner (United Nations Sustainable Development Solution Network (UNSDSN), 2022). According to the sustainable development report of 2022, SDGs are a critical roadmap in forecasting vision 2030 and beyond. The need to transform the world from a crisis to a feasibly viable society greatly depends on the unison implementation of the SDGs in an cohesive approach (Sachs et al., 2022). Adoption of technology to harness the attainment and implementation of sustainability in an ultimately effective and convenient manner is a strategy for liberation of social and economic stability hence transitioning from crisis to sustainability (Sachs et al., 2022; World Bank Group, 2021).

Stakeholders policymakers makers during the 9th Asia Smart City Conference (ASCC)which was organized by Yokohama City in collaboration with the World Bank Tokyo Development Learning Center (TDLC) on January 18, 2021, argued that sustainable development inequalities are the great hindrance towards sustainability hence need for smart technologies (AI, Bigdata and data analytics, 5G, and other data-driven techniques) adoption to bridge the sustainability gap (World Bank Group, 2021).

The onset and stay of COVID-19 pandemic, awakened nations to acknowledge the significance of ICT in the service industries landscape. Nations worldwide have begun to see the significance of uninterruptable technologies towards recovery and revival of economy, healthcare , education, research, and agriculture sectors (Yang et al., 2020).

**The state of SDGs quagmire- progressive stagnation**

The SDGs have reached a point where the world is no longer making progress, due in part to slow or nonexistent recovery in poor and vulnerable countries. This is evidenced by the

marginal decrease of the average SDG Index score in 2021 (Sachs et al., 2022) as illustrated in figure 1 below. SDGs progress has been slackened as a result of numerous and interconnected security and health challenges which bring about significant sustainable development uncertainties. In many low-income countries (LICs) and lower-middle-income nations, performance on SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth) remains below pre-pandemic levels (Sodergren, Kapsos, & Karkee, 2022). This is a significant setback, especially in light of the fact that, prior to the pandemic, the world was making progress toward the SDGs at a rate of 0.5 points annually over the period of 2015–2019 (which was also too slow to meet the 2030 deadline), with poorer countries experiencing greater gains than rich countries (United Nations, 2022).

The disintegrated and unbearable SDGs adoption rate requires a great focus towards implementation of smart technology as a catalyst for the attainment of SDGs.

The interdependency that exists between the SDGs call for proactive mechanisms that promote their unison attainment. Persons with disabilities are at a great risk of exclusion on economic liberty, access to quality education, formal economic scheme and negligence on employment opportunities hence a crisis within (ILO, 2022).

The Attainment of SDG 10 (Reduced inequalities) in SDG 8 (decent working condition and economic growth), has been greatly hampered by inequalities between people with disabilities which calls for smart ICT techniques to establish informal economy platforms (ILO, 2022).

**AI, Big data and analytics, 5G and BGB for the rescue of sustainable development**

ICTs not only played a key role in COVID-19 pandemic relief when the pandemic was at the mid of its turmoil, but also it has proven to be a crucial tool for boosting long-term resilience to upcoming pandemics and for addressing the supplementary problems that arise in a socially isolating setting (Bajpai, Biberman, & Ye, 2020). The sophisticated nature of sustainability scope existing within the 17 SDGs results to processing of large semi-structured or ruther unstructured data components. Inorder to meet informed decisions that correspond to leadership and control objectives of the SDGs the data items should be hearnessed to remain in course with vision 2030 timeline which is almost elapsing.

**Artificial intelligence (AI)-** will promote fully autonomous societies hence hastening transformation and transitioning to definitive utopia communities. AI will provide a powerful framework towards circular dynamic economy and comparative and comprehensive sustainable livelihood (Miteva, 2022). AI will provide a potential to help tackle the most nagging challenges of economy and social life.
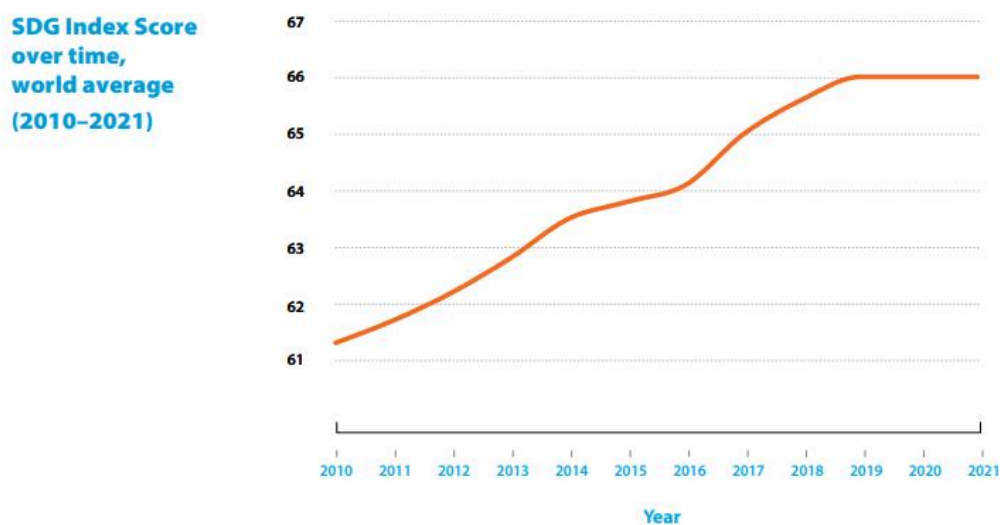


**Fig. 1**: SDG index score over time from the year 2010-2021

Source (Sachs et al., 2022)

Devices like robots will liberate the world's economy by promoting a 24hours economy hence increasing productivity in our manufacturing industries thus increasing the revenue output. Introducing AI to our global market will promote the feasibility of Customers relation management (CRM). With the help of AI's capabilities, such as intelligent predictions and tailored recommendations, a business can determine whether a decision is likely to have a positive return on investment (ROI) or what action should be taken next to have the best chance of maximizing profits. Additionally, an AI CRM may enhance insights, improve opportunity analysis, and establish fully automated commercial relationships with customers (Lange, Pohl, & Santarius, 2020; Valuer, 2022).

AI will promote a comparable economical analytics and insights. With the help of AI, a business entity can better understand its customers. AI systems gather a ton of information and data, in order to gain a comprehensive understanding of the customers and the market's potential, these massive data items are evaluated to promote sustainable economic development (Korneti, 2021). AI algorithms will help a business entity to analyze vast amount of data, perform pattern analytics and interpret their meaning using cognitive insights to identify industry trends (Korneti, 2021; Valuer, 2022).

A positive feedback loop of increased productivity, income growth, and demand brought on by AI may result in more jobs and prosperity. The authors of this paper concurs with Jacques Bughin, of McKisney Global institute on his emphasis on embracing AI for exponential economic growth on his remark about "*AI is not moving away from the SDGs – marrying the two is a matter of ambition and proactivity*" (McKinsey Global Inistitute, 2018). Nations have begun to see the significant value of embracing AI for promotion of sustainable development, where by China has emerged as a champion by structuring a national AI strategy and investing heavily in AI and data driven technologies for service and industrial application (Kathawala & Walter, 2017). On the same scope there has been an increase in AI companies establishment that provide economic support to business and other service industries and provide remote monitoring of economic forces for the benefit of smart economy uplift (Rambach, 2022). AI provide a potential broad solution for

social and economic domains ranging from crisis response, economic empowerment, educational challenges, environmental challenges, equality and inclusion, healthcare, information verification and validation (Chui et al., 2018) as represented in figure 2 below.

**5G and BGB –** The development of ultra-fast 5G wireless technology has been widely hailed as having the potential to alter the society positively. This is not just exaggeration. Progress toward fulfilling the 2030 Agenda for Sustainable Development, which was unanimously accepted by the United Nations, is one area in which 5G will play a crucial role (World Economic Forum, 2019). For instance, considering SDG 4- ensuring inclusive and equitable education for all is one of the major goals that 5G will promote beyond reasonable doubts. 5G and beyond 5G(BGB) will create a stable digital infrastructure for equitable access to educational contents in Realtime by providing a virtual interactive learning session between the student and the teacher (Jagannathan, 2021). 5G will open up digital opportunities for embracing a more interactive online user experience hence uninterruptable technology (Jagannathan, 2021).

5G will promote sustainable development in the following ways in the following core sectors;

a. **economy**

i. **Industrial Network** - Facilitating high-speed communications, Real-time transactions and obile/wireless access to diverse endpoints commissioned in enormous volumes (Kumar, 2022; World Economic Forum, 2019).

ii. **Manufacturing Productivity -** ICT industry will be directly Impacted. Indirect benefits and productivity gains enable the mobile and connected Accessories industry to contribute nearly trillions to the global economy (Ericsson, 2021).

iii. **Employment -**Thousands of new jobs expected in the 5G Operations and supplying industries.
People will embrace remote working and remote job operations which will be seamless on 5G networks (Abdelkafi & Pero, 2018; Ageron, Lavastre, & Spalanzani, 2013; Büyüközkan & Göçer, 2018; Crupi et al., 2020; Grant, Wallace, & Spurgeon, 2013; Hermawan & Gunardi, 2019; Olokundun et al., 2022).

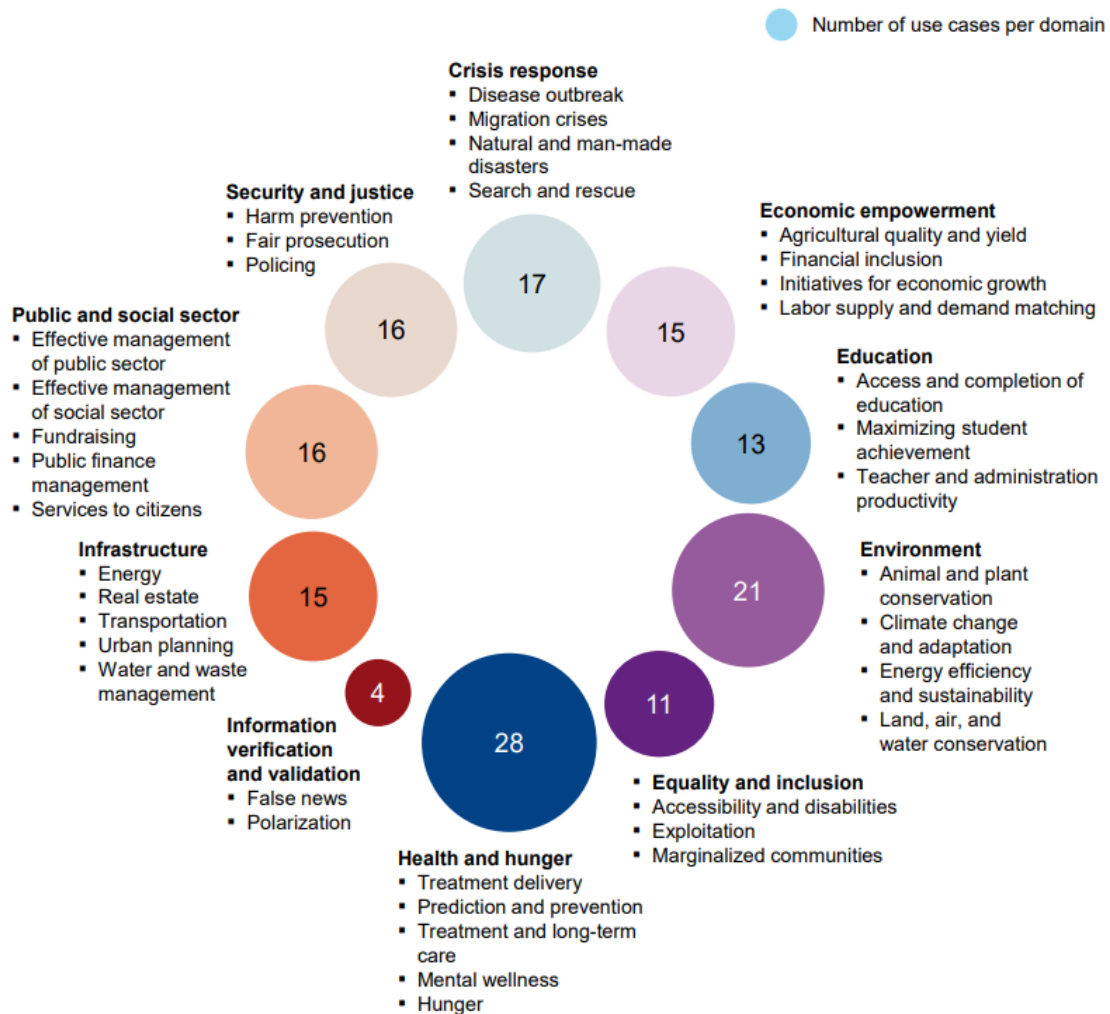**Mapping domains to issue types and use cases in our library.**



**Fig. 2**: Application domains of AI for social good

Source (McKinsey Global Institute analysis 2018)

**b. Social**

i. Increased mobile broadband connections will promote social inclusion and assist in addressing societal demands for entrepreneurship, e-government, education, and health.

ii. link to millions of devices in a crowded area, enabling a range of purposes from smart homes to agriculture and smart factories, where ongoing, granular monitoring is necessary to increase production and efficiency.

iii. **Public standards quality:** 5G connectivity could enhance how we learn, how we utilize banking services, and how robots talk to one another. Education, healthcare, and financial access as a result allow societies to raise standards at every level.

**c. Environmental**

i. **Energy Efficiency:** The speed, capacity, and connection of 5G will present numerous opportunities for environmental protection and preservation. Compared to 4G, 5G will require significantly less energy to operate. By combining IoT with 5G technology, we can improve energy efficiency, lower greenhouse gas emissions, and expand the usage of renewable energy sources.

ii. **Environmental Decision-Making:** 5G-connected real-time sensors, cameras, and smartphones enable us better understand the environment and, as a result, make better decisions regarding the weather, agriculture, pests, business, and waste management (Darrell M. West, 2016; Huseien & Shah, 2021).

iii. **Scaling 5G:** Environmental Monitoring IoT technologies to monitor harmful environmental elements like sulpher and methane can help to mitigate some of the negative effects of cities on the environment and public health. such as Smart Dustbins.

**Big data and analytics –** converting huge volumes and complex meaningless data from a challenge to sustainability development opportunity framework. Big data is characterized by huge data volumes, high velocity of data generation, different varieties of data items, and quality which is less controllable (Odhiambo & Umar, 2019). The complexity associated with repackaging and analysis of large volumes of sustainable development data posts a great issue in decision making for sustainable development, in order to bring sense to the unstructured, huge volumes of data generated at a high velocity Big data analytical algorithms are used to mine the data, perform sorting to bring meaning to the data (Odhiambo & Umar, 2019) as represented in figure 3 below.
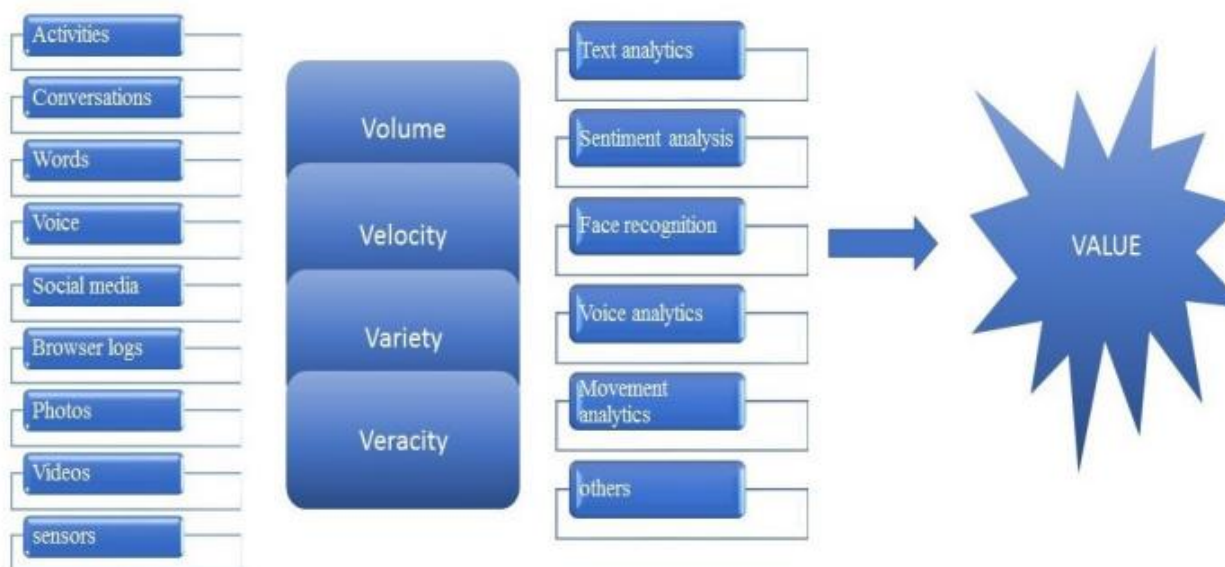
**Datafication of big data**



**Fig. 3**: A conceptual framework for generating meaning out of big data
Source(Odhiambo & Umar, 2019)

Data for sustainable development decisions can be mined if different formats (activities, conversations, words, voice, social media, etc) the data primarily consist of complexity in form of (volumes, velocity, variety and veracity) later on data analytical algorithms are employed to analyze the data which can be used to inform on an effective decision (**value**).

Big data can embrace sustainable development in the following ways as summarized in the following table;

**Tab. 1**: Big Data for SDGs

| S/N | SDGs | Possible Use of Big Data |
|---|---|---|
| 1 | No Poverty | Spending patterns on mobile phone services can provide proxy indicators of income levels |
| 2 | Zero Hunger | Crowdsourcing or tracking of food prices listed online can help monitor food security in near real-time |

| | | |
|---|---|---|
| 3 | Good Health and Well-Being | Mapping the movement of mobile phone users can help predict the spread of infectious diseases |
| 4 | Quality Education | Citizen reporting can reveal reasons for student drop-out rates |
| 5 | Gender Equality | Analysis of financial transactions can reveal the spending patterns and different impacts of economic shocks on men and women |
| 6 | Clean Water and Sanitation | Sensors connected to water pumps can track access to clean water |
| 7 | Affordable and Clean Energy | Smart metering allows utility companies to increase or restrict the flow of electricity, gas or water to reduce waste and ensure adequate supply at peak periods |
| 8 | Decent Work and Economic Growth | Patterns in global postal traffic can provide indicators such as economic growth, remittances, trade and GDP |
| 9 | Industry, Innovation and Infrastructure | Data from GPS devices can be used for traffic control and to improve public transport |
| 10 | Reduced Inequality | Speech-to-text analytics on local radio content can reveal discrimination concerns and support policy response |
| 11 | Sustainable Cities and Communities | Satellite remote sensing can track encroachment on public land or spaces such as parks and forests |
| 12 | Responsible Consumption and Production | Online search patterns or e-commerce transactions can reveal the pace of transition to energy efficient products |
| 13 | Climate Action | Combining satellite imagery, crowd-sourced witness accounts and open data can help track deforestation |
| 14 | Life Below Water | Maritime vessel tracking data can reveal illegal, unregulated and unreported fishing activities |
| 15 | Life on Land | Social media monitoring can support disaster management with real-time information on victim location, effects and strength of forest fires or haze |
| 16 | Peace, Justice and Strong Institutions | Sentiment analysis of social media can reveal public opinion on effective governance, public service delivery or human rights |
| 17 | Partnerships for The Goals | Partnerships to enable the combining of statistics, mobile and internet data can provide a better and real- time understanding of today's hyper-connected world BIG DATA SDGs How data science and analytics can contribute to sustainable development |

Big data enhance the provision of government services, supplement official statistics, and speed up development in fields including health, urban planning, transportation, and humanitarian aid. Furthermore, open-source technologies have expanded people's options for conducting big data analyses outside of proprietary and pricy software packages, and dropping prices and greater functionality have democratized data consumption (Center for Strategic and International Studies (CSIS), 2017). Big data for development (BD4D) is a relatively new concept, but interest in collecting and using huge data sets for public purposes has grown since the post-2015 development agenda called for a data revolution to use both old and new sources of data to track the new Sustainable Development Goals (SDGs) (IDRC - International Development Research Centre, 2020) .

**Conclusion**

The implementation and attainment of SDGs is a priority for embracing sustainable development. Integration of AI, big data and analytics, and 5G to sustainability development is a strategy that need

to be embraced and adopted in order to catapult the achievement of vison 2030 agenda before its too late. The integration of data driven techniques will open up new opportunities to leverage sustainable development achievement to the virtual and beyond the visible boundaries of social, economical and environmental pillars. The new framework of suitable development will not be spelled complete if cyber security issues can't be addressed to guarantee protection in the cyber/digital space, cyber security will provide a fully integrated package of digital sustainability roadmap. Its early time we collaborate in wetting the ground for the frog to leap before we realize we are in the year 2030 without the development agenda.

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