


Harnessing AI, IoT, and Big Data for social and economic growth in Africa: A Bibliometric review



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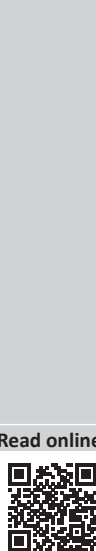
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Orientation: Because of the critical contribution of new technologies to innovation and their potential for global economic growth, artificial intelligence (AI), Internet of Things (IoT) and Big Data have surged in academic research.

Research purpose: This review aimed to examine recent research on these technologies and explore how the African continent can leverage them to address its pressing developmental needs.

Motivation for the study: Technology is no longer a supplementary tool but rather a major driver of advancement. Technologies such as AI, the IoT and Big Data are addressing global difficulties, boosting productivity and encouraging innovation.

Research design, approach and method: The search approach involved locating pertinent databases, specifically on Scopus, JSTOR and Lens. A total of 187 articles were analysed using the Bibliometrix platform and AI for more complex graphs.

Main findings: The review findings revealed that Big Data, IoT and AI have the potential to revolutionise society and drive development worldwide, including in Africa, while also facilitating the achievement of the United Nations Sustainable Development Goals 8, 9, 13, 15 and 17.

Practical/managerial implications: Adopting AI, IoT and Big Data not only presents opportunities but also challenges for the African continent's tech-driven development. If carefully utilised, they could assist low-income nations in Africa in overcoming historical obstacles.

Contribution/value-add: The contribution of this study lies in the spotlight it has shed on the potential of these new technologies for African development, thereby encouraging further research, particularly empirical research, to track their impact on the ground.

Keywords: Africa; artificial intelligence; Big Data; internet of things; social and economic growth.

Introduction

Industries such as banking, agriculture, education, business, health and governance are changing as a result of the quick growth of technology like artificial intelligence (AI), the Internet of Things (IoT) and Big Data (Golubnitschaja et al. 2020; Hussain, Dawood & Al-Turjman 2021; Jain et al. 2020; Moon et al. 2023). These technologies are addressing global difficulties, boosting productivity and encouraging innovation; nonetheless, they are also posing ethical, social and economic challenges (Allen et al. 2025; Saheb 2022). The 21st century has witnessed an unparalleled technological transformation that continues to change how societies, economists and problem solvers operate. Technology is no longer a supplementary tool but rather a major driver of advancement, as evidenced by the inter-connection promoted by the IoT, the insights gained from the enormous ocean of Big Data and the revolutionary potential of AI. People throughout the world are struggling with how to strategically use those advancements to solve problems, open up new opportunities and promote sustainable development (Kharad & Thakur 2023; Liu et al. 2022).

To stay at the forefront of this technology transformation, advanced economies are making significant investments in research and development (R&D), constructing strong digital

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infrastructure and developing the requisite skills (Liang et al. 2022; Soete et al. 2021; Yadav 2024). Acknowledging the leapfrogging potential, emerging nations are actively investigating how new technologies might improve public services, empower their citizens and accelerate their growth trajectories (Abbasi, Wu & Luo 2024; Kalaba 2023; Santoni de Sio 2024). Effectively utilising IoT, Big Data and AI is quickly becoming a defining characteristic of a country's competitiveness as well as its potential to attain long-term prosperity and well-being.

Under these circumstances, the African continent stands at a pivotal moment in its history. The continent presents a distinctive and alluring environment for tech-driven development as it has what is perhaps the youngest population in the world, a fast-expanding middle class and rising rates of urbanisation (Kalaba 2023; Ogbuke et al. 2023). Even though the continent continues to face historical obstacles in the areas of governance, education and infrastructure, it is becoming more aware of how digital technology might revolutionise old growth paths. Cutting-edge technologies such as IoT, Big Data and AI are being adopted and adapted in large quantities because of the proliferation of mobile technology, the expansion of Internet connectivity and the rise of the tech-savvy generation (Asif 2020; Emma 2024; Kalaba 2023).

These technologies have enormous potential for Africa. Artificial intelligence has the potential to revolutionise several African industries, including urban management, healthcare, agriculture and financial inclusion. Big Data analytics, for example, can provide invaluable insights into social trends, resource allocation and the effectiveness of policies, facilitating data-driven decision-making to enhance governance and service delivery. Moreover, IoT has the potential to transform industries such as precision farming in agriculture, remote monitoring and diagnostics in healthcare and infrastructure management through 'Smart City' projects (Abbasi et al. 2024; Huang et al. 2022; Khan, Umer & Faruque 2024; Liu et al. 2022). Artificial intelligence can also improve social and financial inclusion, personalise healthcare and education, automate complicated processes and spur industry-wide innovation.

However, in many regions of Africa, significant obstacles remain that must be addressed to fully leverage these new technologies. A lack of infrastructure, for instance, restricts the use of technology in underserved and rural areas, especially when it comes to energy and dependable Internet connectivity (Allen et al. 2025; Kalaba 2023; Omolara, Alawida & Abiodun 2023; Saheb 2022). Furthermore, the prevalence of digital literacy varies significantly by area and demographic category (Moon et al. 2023; Santoni de Sio 2024). Similarly, inventors and investors face uncertainty, as legal frameworks and laws often seem to lag technological innovation. Considering the aforementioned, this review aims to examine recent research on these technologies and how the African continent can leverage them to address its pressing developmental needs.

Research methods and design

Research objectives

The primary objective of this review is to comprehend and assess the impact, trends and structure of research on the role of AI, the IoT and Big Data on Social and economic growth in Africa. This analysis will also help to identify opportunities and challenges, highlight emerging research areas and suggest future research recommendations.

Search methods

To locate and examine research and literature on the evolution, patterns and potential effects of AI, IoT and Big Data on social and economic progress in Africa, a narrative review process has been followed. The search approach entailed locating a pertinent database, specifically Scopus, JSTOR and Lens. Because most of the articles found on these search engines are also found on other search engines such as Web of Science, ResearchGate, Google Scholar, etc., and because they offer a comparable flexible connection with a wide range of searching capabilities across a vast number of online scholarly published article, it was judged that these are sufficient for the purpose of this study. Books, journal articles, conference papers, dissertations and theses were among the various forms of literature considered for review. The time frame considered was 2020–2025 because the authors perceived the topics as relatively new in research and accelerated by the advent of the coronavirus disease 2019 (COVID-19) pandemic (2019–2020). Furthermore, during that period, there has been an emergence of key publications, trends or technological developments in AI, IoT and Big Data that also justify the choice of the period. Because of the review's exploratory nature, it did not employ a more inclusive approach to article selection, such as the one used in systematic reviews, which also requires more advanced knowledge of the methodology.

The search technique used free words or expressions linked with Boolean operators such as 'OR' and 'AND' and included AI, the IoT, Big Data, Africa or the African continent. The search results produced 240 articles and papers. All studies deemed irrelevant to this review or lacking all four main keywords or their variations (i.e. artificial intelligence or AI; IoT or IoT, Big Data, Africa or African) were excluded from the review. Moreover, articles that were published in languages other than English are not considered. A total of 187 articles were finally considered for the review. These articles were exported to Bibliometrix via the RStudio platform for first-hand data analysis, where graphs were plotted and data tables were produced for further analysis of the findings. The graphs from Bibliometrix were analysed for insights by the authors, and more complex graphs – such as Collaboration Network, Thematic Map or Most Prolific Contributors – were analysed with the assistance of Generative AI (Gemini, ChatGPT, Claude AI). The mitigation of the inherent bias in these tools is detailed in the Acknowledgements section.

Ethical considerations

The authors did not collect primary data, had no direct interaction with human participants or animals and processed no identifiable personal information. All ethical standards were followed for research with no direct contact with humans or animals.

Findings

Digital platforms, transformation in education and public services

A noticeable trend is the digitisation of public services to increase inclusion and efficiency. In fact, AI-driven technologies, e-governance platforms and mobile apps are simplifying public sector operations, enhancing transparency, promoting cultural tourism and facilitating citizen-centric strategies (Fan & Chen 2024; Rymarczyk 2020; Snowball, Tarentaal & Sapsed 2021). In addition to making service delivery easier, digital platforms are fostering innovation and entrepreneurship, especially in the fields of education and health. For instance, although inequalities in digital access still exist, AI is transforming science, technology, engineering and mathematics (STEM) education, individualised learning and curriculum development (Abbasi et al. 2024; Hernandez-de-Menendez, Díaz & Morales-Menendez 2020; Su & Ding 2022; Xiao et al. 2024). Innovation in emerging markets, especially in handicrafts and small-scale businesses, is being stimulated by technology-driven entrepreneurship (Acs et al. 2021).

Internet of Things, machine learning, and artificial intelligence for predictive insights and healthcare integration

Artificial intelligence is being used for controlling urban infrastructure, forecasting disease outbreaks and increasing agricultural output, among other applications (Gutierrez & Bryant 2022; Schor et al. 2020). Likewise, decision-making in contexts with limited resources and drug discovery is also being aided by machine learning (ML) models (Anthwal et al. 2024; Munoth, Anilkumar Nagaich & Gehlot 2022). Predictive, preventative and personalised medicine (3 PM) is being revolutionised by AI and IoT, which is improving patient monitoring, treatment planning and diagnostics (Fazio et al. 2021; Golubnitschaja et al. 2020). Digital health platforms utilise AI to enhance drug safety and efficacy through pharmacovigilance – the monitoring of the effects of medical drugs – particularly in situations with limited resources (Fazio et al. 2021).

Data privacy and the proliferation of digital financial services

Fintech technologies such as digital wallets, mobile money and decentralised finance (DeFi) platforms are expanding financial inclusion, particularly for marginalised groups in the Global South (Choithani et al. 2022; Preziuso, Koefer & Ehrenhard 2023). To counteract deepfakes, false information and cyber threats in IoT networks, cybersecurity tools

driven by AI are being developed. For instance, Federated learning and blockchain are becoming popular options for safe, decentralised data management (Gutierrez & Bryant 2022).

Ethical artificial intelligence, Big Data, and use in policy design

Ethical AI frameworks are becoming more and more important in order to address issues of responsibility, privacy and bias in automated decision-making (Bugár & Somogyvári 2025). Risks of monitoring and digital authoritarianism are being discussed, especially in light of AI-driven government (Afroogh et al. 2023; Allen et al. 2025; Cosa & Torelli 2024; Pawelec 2024; Santoni de Sio 2024). Data-driven development is becoming more and more important, and Big Data analytics should make policy frameworks more flexible and responsive (De-Lima-Santos, Yeung & Dodds 2024; Raman et al. 2024; Saheb 2022).

Sustainable development and smart cities

Artificial intelligence and IoT are being used, especially in emerging economies, for climate resilience, disaster management, sustainable agriculture and environmental protection, as well as for smart urban planning (Ngulube 2025; Okpala & Nzeanorue 2024; Perlaza Rodriguez 2024; Zhang et al. 2024). Big Data analytics and digital twins maximise resource efficiency in infrastructure, energy and agriculture (John 2021; Singh & Dey 2023). Furthermore, AI and Big Data are being used to help with natural hazards management, both in rural and urban areas (Li et al. 2024).

Bibliometric analysis

The most relevant keywords identified in the literature from the authors whose articles were considered for the review are displayed in the Word Cloud in Figure 1. Some words or phrases that are spelled differently (e.g., IoT and/or AI) have been combined for the sake of consistency and to avoid repetition of the same keyword.

Analysis of the figure and implications for the research on ‘Tech-Driven Development’ in the African context:

- **Visual importance:** The word cloud offers a concise, visual summary of the main ideas and themes.
- **Word size:** Each word’s size in the cloud reflects how frequently or how important it is. Greater frequency or greater relevance is indicated by larger words.
- **Key themes:** Artificial intelligence, IoT, and Big Data are the most prominent terms, indicating their pivotal position in this field of study. The metaverse appears as an emerging theme but with a lower frequency of occurrence.
- **Associated phrases:** The cloud encompasses several phrases associated with the research topic, including ‘climate change, sustainable development goals, digital technology, smart city, metaverse, and economic and social effects’.



Note: This figure was created using a bibliometric analysis output. For more information, please visit: <https://doi.org/10.4102/ac.v26i2.1526>.

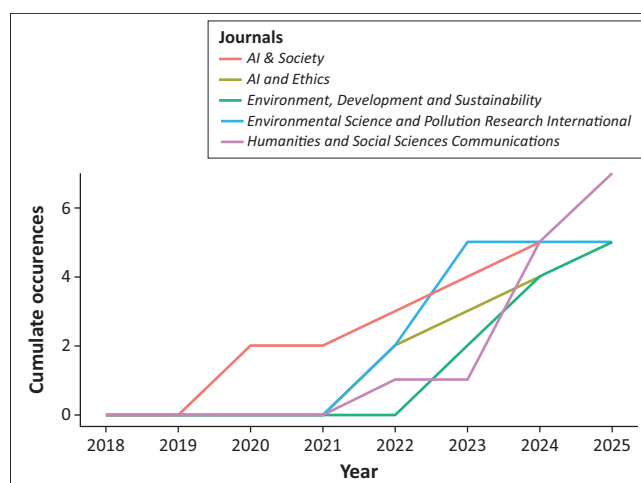
FIGURE 1: Word cloud.

The Word Cloud highlights the importance of focusing on core technologies, such as AI, the IoT, and Big Data in Africa to address its unique challenges and opportunities. It also emphasises the need to align technology with the Sustainable Development Goals (SDGs) and climate change mitigation. The cloud further emphasises the importance of digital transformation, smart cities, emerging technologies such as the Metaverse and Virtual Reality and the need to consider the broader social, economic and ethical implications of technology adoption in Africa.

Publication trends over time

Figure 2 illustrates the production trends of the top five publications over time. It is worth noting that almost all of them have seen an increase in the number of publications, especially since 2021, arguably because of the COVID-19 pandemic, except for *AI & Society*, which began increasing in 2019. *Artificial intelligence and Ethics*, as well as *AI & Society* (five articles each), emphasise a deep concern with responsible AI. *Environment, Development and Sustainability*; *Environmental Science, and Pollution Research International* (five articles each) demonstrate that the research is directly tied to the SDGs.

As ethical and sustainable development concerns are frequently overlooked in the Global North's technology-driven research, this alignment presents a significant opportunity for African research to take the lead in the global discussion on responsible technology deployment. This strength should be leveraged by African scholars to secure financing and establish themselves as thought leaders.



Note: This figure was created using a bibliometric analysis output. For more information, please visit: <https://doi.org/10.4102/ac.v26i2.1526>.

AI, artificial Intelligence.

FIGURE 2: Publication trends over time.

Top journals and publications

The leading sources (journals or publications) found in the reviewed articles are listed in Figure 3, organised by the number of articles. The research group's primary theme emphasis and publication priorities are established by these sources.

The profile of these sources demonstrates a highly transdisciplinary, policy-aware and ethically focused research network, posing a unique challenge for African stakeholders while also presenting a significant strength. The strength lies in the emphasis on sustainable and responsible AI, with the majority of the top three theme

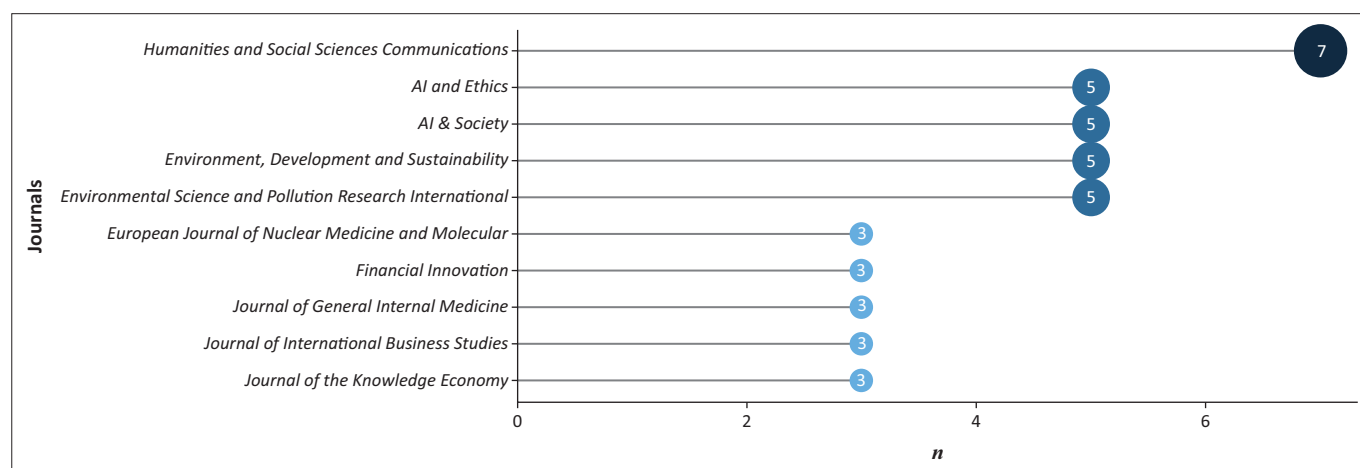
areas focusing on ethical governance and development. An ethical priority is one noteworthy conclusion that AI and ethics were equally weighted in the top sources (five articles each). It demonstrates that the responsible development and control of AI are being given top priority, which is an unavoidable necessity for African nations struggling with high inequality, algorithmic bias and data scarcity. The network's research and resource management, as well as its climate action, are closely related, as evidenced by the equal weighting of Environment, Development and Sustainability and Environmental Science and Pollution Research International (five articles each).

A few implications of these top journals and applications of the review are observed here. Implication: By emphasising accountability and inclusiveness and mitigating the risks of exacerbating current disparities with technology, this review

is already geared towards achieving UN SDG 16 (Peace, Justice and Strong Institutions). The first implication is that the study is highly relevant locally and directly supports the continent's existential concerns, as expressed in SDGs 13 (Climate Action) and 15 (Life on Land). The second implication is that using the intellectual reputation associated with publishing in these publications to promote African-owned journals and institutional repositories is a challenging task. To ensure that knowledge is localised and widely accessible to African policymakers and practitioners, African funding organisations should provide incentives to authors who publish findings (or modified versions) in regional publications.

Top authors and regional focus

Table 1 lists the top contributors by their total number of publications (TPs).



Note: This figure was created using a bibliometrix analysis output. For more information, please visit: <https://doi.org/10.4102/ac.v26i2.1526>. AI, artificial Intelligence.

FIGURE 3: Top journals and publications.

TABLE 1: Top 20 most prolific contributors.

Rank	Contributor name	Publications (n)	Fractional contribution	Contributor type	Geographic focus
1	Anderson J	9	4.17	Individual author	Global
2	Rainie L	9	4.17	Individual author	Global
3	Naudé W	5	4.50	Individual author	Africa and/or global
4	Li Z	5	0.90	Individual author	Global and/or Asian
5	Abdella S	3	0.38	Individual author	Africa
6	Adams R	3	0.38	Individual author	Africa and/or global
7	Adeleke F	3	0.38	Individual author	Africa
8	Alayande A	3	0.38	Individual author	Africa
9	Cloete Deon	3	1.17	Individual author	Africa and/or global
10	European Investment Bank EIB	3	3.00	Global organisation	Africa
11	Gaffley M	3	0.38	Individual author	Africa and/or global
12	Gangadhari RK	3	0.75	Individual author	Global and/or Asian
13	Junck L	3	0.38	Individual author	Africa and/or global
14	Li X	3	0.44	Individual author	Global and/or Asian
15	Liu J	3	0.41	Individual author	Global and/or Asian
16	Salami F	3	0.38	Individual author	Africa
17	Segun S	3	0.38	Individual author	Africa and/or global
18	Wang K	3	0.75	Individual author	Global and/or Asian
19	Zhao Y	3	0.75	Individual author	Global and/or Asian
20	Akram SV	2	0.23	Individual author	Global and/or Asian

Note: This table was created using a bibliometrix analysis output. For more information, please visit: <https://doi.org/10.4102/ac.v26i2.1526>.

Prolific African-focused contributors

The analysis reveals a core group of highly relevant African-focused authors and organisations dedicated to the review's themes. Some of the topics are discussed here. Vim Naudé is a highly cited economist focusing on development economics, digitalisation and AI. His work specifically includes 'The African Entrepreneurial Ecosystem Index', indicating a direct research interest in technology-driven economic growth in Africa (Naudé 2022). Notably, he has the highest fractional contribution (4.50) among the top five individual authors, suggesting a high ratio of first or single-authored articles. Next, Adeleke Fola, a strong African voice in the field, leads the African observatory on Responsible AI and served as a co-chair for the Trust and Regulation workstream for South Africa's National AI Strategy. His research focuses on AI, human rights and policy in Africa (Alayande et al. 2025), making him a central figure in the field of AI governance on the continent.

In addition, Alayande Ayantola is a researcher at the Global Centre on AI Governance whose work focuses on AI development and governance in Africa and low- and middle-income countries. His profile is directly tied to the geopolitical and policy aspects of emerging technology in the region. Furthermore, Segun Fatumo is the chair of 'Genomic Diversity' and focuses on genomics in African Populations, actively leading projects such as the Nigerian 100K genomes project. While in a health context, this highlights significant Big Data and AI applications in Africa. Samali Funbi's name is often associated with authors who research health and environmental issues in Nigeria and sub-Saharan Africa, demonstrating contributions to social and economic outcomes through technology-related fields such as public health analysis (Big Data). Moreover, the European Investment Bank is an important global organisation that supports economic growth and sustainable development in sub-Saharan Africa, aligning with the article's theme of social and economic growth (European Investment Bank 2023).

Prolific global contributors

There are also authors in the review who provided the foundational and broad theoretical context for the study on emerging technologies, which is then applied to the African context. These authors include Anderson, Janna, who is a co-founder and senior researcher at the Imagining the Digital Future Centre, a prolific author whose work focuses on the societal impact of the Internet and digital technology. These foundational works often inform sector-specific studies such as the one reviewed (Anderson, Rainie & Vogels 2021). Also featured is Rainie Lee, director of the Imagining the Digital Future Centre (and former Director of Pew's Internet and Technology Project). His research is focused on the social, political and economic impact of the digital, mobile and social media revolutions globally (Rainie, Anderson & Vogels 2021). In addition, the high frequency of authors with common East Asian surnames (e.g. Li, Wang, Zhao) is typical in the AI, IoT and Big Data literature globally, reflecting the significant research output from Asian institutions,

particularly in computer science and engineering (Li 2024; Wang et al. 2021; Zhao et al. 2022). These authors represent the Global Technology Research Base on which the Africa-focused study draws.

Trending topics

This section looks at how topics were trending among the reviewed article, as shown in Figure 4.

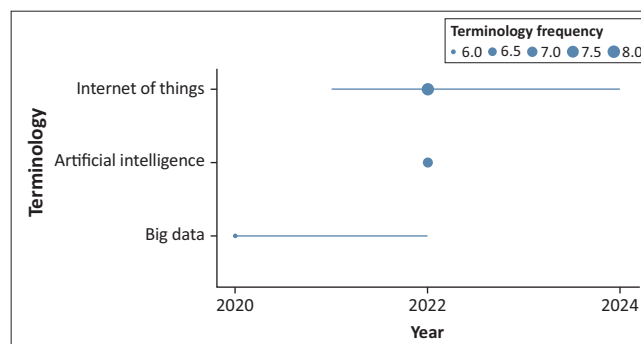
The analysis of the graph shows the following:

- Chronological distribution: From 2020 to 2024, the graphic displays how these phrases are distributed across time.
- Keywords highlighted: Again, the three key terms are highlighted in the plot: IoT, AI and Big Data. These are essential to the subject of the study.
- Term frequency: The circles' sizes indicate how frequently each term occurs. Higher frequency is indicated by larger circles.
- Dominance of IoT and AI: The terms IoT and AI exhibit a comparatively high frequency and steady presence throughout time.
- Big Data emergence: The term Big Data seems to have emerged more recently and with a lower frequency, which could point to a growing trend.
- Yearly distribution: According to the plot, AI and IoT have been steadily advancing in research between 2020 and 2024. In recent years, Big Data has also become more prevalent.

The IoT is a foundational technology that can transform various sectors in Africa, including agriculture, healthcare, infrastructure and environmental monitoring. Equally, AI is a key enabler for financial inclusion, education, governance and language processing. Furthermore, Big Data is increasingly recognised for its potential to inform decision-making and drive insights, such as market analysis, public health tracking, urban planning and disaster management.

Thematic map

This section illustrates (Figure 5) and explains the pertinence of themes from the reviewed articles or papers. Centrality (relevance degree): the horizontal axis denotes centrality,



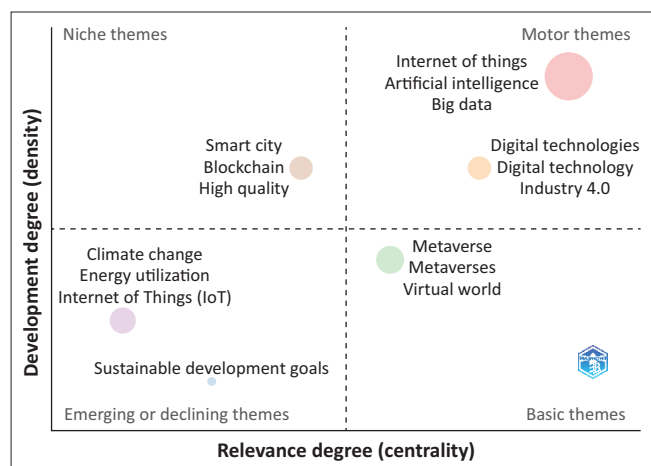
Note: This figure was created using a bibliometric analysis output. For more information, please visit: <https://doi.org/10.4102/ac.v26i2.1526>.

FIGURE 4: Graph showing how topics were trending among the reviewed articles.

which shows how significant or pertinent a theme is to the field. Density (development degree): the vertical axis represents a theme's level of development or research, indicating its density.

The plot is divided into four quadrants:

- Motor themes (upper right): these themes are essential to the field and extremely well developed. They are regarded as essential and motivating factors and include IoT, AI and Big Data.
- Basic concepts (lower right): These are important but underdeveloped concepts. Although they are fundamental, more research on them could be necessary. The themes in this quadrant include Digital Technologies, Industry 4.0 and digital transformation.
- Niche themes (upper left): these are less central yet strongly developed themes. They include Smart City, Blockchain and High Quality. It is surprising that blockchain is placed in this quadrant, as it could also be very important as part of 'Tech-Driven Development' for the African continent.



Note: This figure was created using a bibliometric analysis output. For more information, please visit: <https://doi.org/10.4102/ac.v26i2.1526>.

FIGURE 5: Thematic map.

- Emerging or declining themes (lower left): these themes are not very prominent or fully formed. They could be emerging or dwindling fields of study. The themes include Climate Change, Energy Utilisation and SDGs.

The map highlights the importance of the motor themes in tech-driven development, such as the IoT, AI and Big Data, in Africa. It further emphasises the need for digital infrastructure, digital literacy and Industry 4.0 principles. Additionally, the niche themes suggest specialised opportunities, such as blockchain for financial integration and land registration and smart cities for urban development. On the other hand, the emerging/declining themes suggest areas of interest, such as addressing climate change and achieving the SDGs.

Collaboration networks

Table 2 illustrates plausible collaborations among top authors in the reviewed research. This visualisation helps us to understand the relationships between authors, based on how often their works are cited together by other researchers. The key metrics for understanding author importance are the following. Betweenness measures the author's ability to act as a 'bridge' between different collaboration clusters; a high value means they control the flow of information. Next is closeness, which measures how quickly an author can reach everyone else; a high value suggests rapid dissemination of information. Finally, page rank, which measures an author's overall prestige and influence, factoring in both the quantity and quality of their co-authors.

The two most important knowledge bridges are Li Z (Betweenness = 63.00) and Li X (Betweenness = 27.00). Because of their strong Betweenness Centrality, they serve as necessary bridges to link disparate groupings or clusters. They are the essential channels for sharing information, obtaining resources and establishing new cooperative relationships both inside Africa and with international partners. Also, Raman R (Betweenness = 26.00) serves a

TABLE 2: Collaboration networks.

Node	Cluster	Between-ness	Closeness	Page rank	Role and implication
Li Z	3	63	0.029	0.0524	Critical broker/knowledge bridge: Facilitates vital knowledge transfer between research clusters and African institutions.
Li X	1	27	0.022	0.0325	Critical broker/knowledge bridge: Facilitates vital knowledge transfer between research clusters and African institutions.
Gangadhari RK	3	0	0.022	0.0318	Highly influential scholar/prestige hub: Establishes research credibility and drives the thematic agenda; attracts global collaboration.
Wang K	3	0	0.022	0.0318	Highly influential scholar/prestige hub: Establishes research credibility and drives the thematic agenda; attracts global collaboration.
Zhao Y	3	0	0.022	0.0318	Highly influential scholar/prestige hub: Establishes research credibility and drives the thematic agenda; attracts global collaboration.
Anderson J	4	0	0.5	0.0287	Highly influential scholar/prestige hub: Establishes research credibility and drives the thematic agenda; attracts global collaboration.
Rainie L	4	0	0.5	0.0287	Highly influential scholar/prestige hub: Establishes research credibility and drives the thematic agenda; attracts global collaboration.
Kano L	2	0	0.143	0.0264	Highly influential scholar/prestige hub: Establishes research credibility and drives the thematic agenda; attracts global collaboration.
Abdella S	7	0	0.143	0.0233	African-focused leader: Represents the core capacity of African institutions; ensures local relevance and data context in the research output.
Feyisa Y	7	0	0.143	0.0148	African-focused leader: Represents the core capacity of African institutions; ensures local relevance.

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high-impact brokerage role. Moreover, Li Z (PageRank = 0.0524) has the most influence, overall. This author has significant prestige and gravity inside the network because they are probably the most mentioned. They imply that they determine the research agenda and draw the greatest attention to the output of the network. Many of the writers in cluster 3 have high Page Ranks, indicating that this cluster is currently the collaboration's intellectual centre.

Opportunities and challenges for the African continent

Opportunities

The possible implications of the reviewed literature mentioned earlier suggest that adopting AI, IoT and Big Data presents not only opportunities but also challenges for the African continent's tech-driven development. To corroborate with Khan et al. (2024), carefully used AI could assist low-income nations in Africa in overcoming historical obstacles, especially in the fields of health and education. In addition, in post-COVID-19 settings, the global digital platform economy presents new paradigms for employment and innovation, as posited by Acs et al. (2021). For example, by streamlining supply chains and reducing inefficiencies, AI and IoT can promote economic diversification, particularly in manufacturing, fintech and agriculture. Furthermore, through cooperation between fintech, micro-finance institutions (MFIs) and banks on the continent, open banking models and digital platforms have the potential to democratise finance, enabling financial inclusion for millions of Africans and providing access to international markets for small businesses, thereby promoting inclusive economic development (Preziuso et al. 2023). Because of the continent's tremendous population shift from rural to urban areas, geo-computation techniques can be used to track environmental risks, population mobility and urban change with previously 'unheard of' accuracy (Ngulube 2025; Okpala & Nzeanorue 2024). In addition, AI-enhanced learning tools can democratise education, particularly in underserved regions, and re-skilling programmes can prepare workers for AI-augmented job markets (Abbasi et al. 2024; Su & Ding 2022; Xiao et al. 2024).

Challenges

Low-income nations, such as those in Africa, run the risk of technological marginalisation in the absence of basic infrastructure and inequities in access to technology, especially in rural and low-income areas, which can exacerbate socioeconomic gaps (Khan et al. 2024). Moreover, in low-income nations such as those in Africa, technological integration is slowed by high prices, opposition to change and a lack of digital literacy (Selwyn & Jandrić 2020). Likewise, concerns about data privacy, ethics and surveillance in payments are equally pressing. For instance, Bugár and Somogyvári (2025) found serious ethical concerns with digital payment systems, particularly with relation to access, equity and surveillance. Moreover, not only do data centres and AI models use a lot of energy and contribute to carbon

emissions, but also e-waste from IoT devices also presents sustainability issues that must be addressed when it comes to the African continent (John 2021; Okpala & Nzeanorue 2024; Singh & Dey 2023; Zhang et al. 2024).

Recommendations

The future of AI requires ethical guidelines, data laws, infrastructure investment, education, sustainable innovation, inclusive development, foundational infrastructure, ethical tech ecosystems, data governance gaps and platform reforms. International cooperation is necessary for effective IoT governance, and broadband access should be expanded, particularly within the African continent. Education should also integrate AI literacy. Sustainable innovation should focus on energy-efficient AI, and inclusive development should prioritise equity in tech programmes. Furthermore, data governance should prioritise the privacy and dignity of vulnerable groups.

Future research paths

Research on tech-driven development should consider temporal trends and research focus, concentrating on the most recent uses of these technologies in the African context. The following are some recommendations as focus for research on the African continent:

- Artificial intelligence for fairness in society: examining how AI might lessen societal inequality rather than make it worse and examining how automation will affect labour markets in the long run.
- Ethical and explainable AI: creating open AI models with integrated fairness checks and observing governance structures for the accountability of AI.
- Internet of Things privacy and security: investigating decentralised AI and lightweight encryption for IoT networks and evaluating the dangers of surveillance using AI in smart cities.
- Artificial intelligence -human cooperation: analysing how AI may support human decision-making in governance, healthcare and education – not replace it and examining user confidence in AI-powered technologies.
- Climate-adaptive technology: exploring how AI is being used in sustainable agriculture, carbon capture and climate modelling and testing smart grids with IoT capabilities to optimise renewable energy.
- Digital labour structures: because gig economy experiences vary widely, platform architecture and governance research is necessary (Schor et al. 2020).
- Inclusive financial innovation: upcoming research should assess whether fintech and banking hybrid models truly accomplish inclusion (Preziuso et al. 2023).
- Human-centred Big Data: Gutierrez and Bryant (2022) suggest conducting multidisciplinary research to determine how Big Data systems impact human rights and humanitarian consequences.
- Longitudinal studies on health tech: tracking long-term impacts of digital health tools (Golubnitschaja et al. 2020).

Conclusion

This review has demonstrated that Big Data, IoT and AI have the potential to revolutionise society and drive development worldwide, including in Africa. However, their proper application necessitates resolving issues of inclusivity, security and ethics (Allen et al. 2025; Khan et al. 2024). To ensure fair advancement, ethical AI, IoT security, Big Data and sustainability should be given top priority in future research in Africa, as outlined in the future research paths section. Moreover, the opportunities spelled out in this review, if leveraged effectively, could arguably help achieve, at least partially, the United Nation (SDGs) such as SDG 8: Decent Work and Economic Growth – the mentioning of ‘boosting productivity’, ‘encouraging innovation’ and driving ‘African economic development’, directly aligns with promoting sustained economic growth and productive employment; SDG 9: Industry, Innovation and Infrastructure – the focus on AI, IoT and Big Data as transformative technologies that drive innovation and address global challenges directly supports building resilient infrastructure and fostering innovation; SDG 17: Partnerships for the Goals – the research’s focus on leveraging global technologies for African development inherently promotes international cooperation and knowledge sharing. Other SDGs that could be facilitated include SDGs 13 (Climate Action), 15 (Life on Land) and 16 (Peace, Justice and Strong Institutions).

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The authors utilised a large language model (Gemini) to aid in the analysis of more complex Bibliometric plots and tables, such as collaborative networks, thematic maps or top authors and publications. Insights into the implications of these plots and/or tables were also helped by other large language models (DeepSeek and Claude AI). Artificial intelligence tools, such as large language models (LLMs), may have biases because of the vast datasets on which they were trained. These biases include data bias, which may over-represent certain geographical contexts or cultural norms; representational bias, which may perpetuate societal stereotypes about gender roles and algorithmic or confirmation bias, which can limit the exploration of novel findings. To mitigate these biases, AI tools are used for data organisation, thematic identification and initial drafting, rather than independent writing or critical analysis.

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

CRedit authorship contribution

Bouba Ismaila: Conceptualisation, Data Curation, Formal Analysis, Methodology, Writing-Original Draft. John D. Beneke: Writing-Review & Editing. All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication and take responsibility for the integrity of its findings.

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The list of articles used for this review and the Bibliometric analysis output are available from the corresponding author, Bouba Ismaila, upon reasonable request.

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