

HOW BIG
DATA
ENABLES AND
CONSTRAINS
AI
DEVELOPMENT
IN AFRICA

How Big Data Enables
and Constrains AI
Development in
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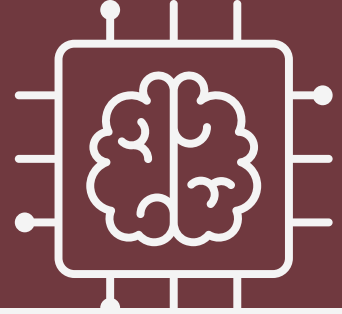
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Africa has received various forms of aid and investment from foreign governments, such as the US, that aim to promote private sector participation in its energy, healthcare, and agriculture sectors. However, potential investors, both public and private, often lack comprehensive data on the economic and financial viability of different projects and countries in Africa. Therefore, they tend to avoid investing in the continent. If African governments want to attract more business finance and encourage high-quality and sustainable investments, especially from local and intra-continental sources, they need to provide better data to investors.

This data is largely generated and held by the private and sometimes the public sectors, but it is often unprocessed or unanalysed for development purposes. This data is known as big data – a term that refers to the collection, processing, and analysis of large and complex data sets that cannot be handled by traditional methods. Big data sources include social media, mobile transactions, GPS signals, sensors, and many more. Big data has the potential to provide valuable insights and solutions for various domains, such as security, health, education, agriculture, and governance.

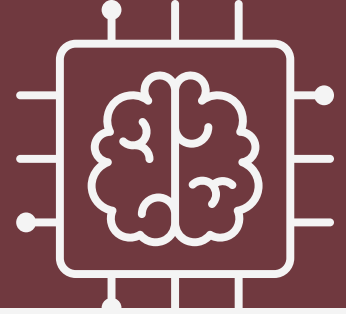
As the amount of data collected by businesses across Africa grows, tools that can process this valuable asset and turn it into actionable information are becoming increasingly important for companies.

Big data solutions, including artificial intelligence, predictive analytics and machine learning, are able to sort through huge data sets and return commercially useful insights, which conventional technologies are unable to perform. According to a report from consulting firm Frost & Sullivan, the Middle East and Africa's big data analytics market is forecast to grow by 28% every year until 2025, reaching revenue of \$68bn.¹

The proliferation of mobile devices, increasing internet penetration, and the expansion of digital services have contributed to the exponential growth of data generation in Africa. This abundance of data provides a valuable resource that can fuel AI advancements across diverse domains. AI has become a pervasive technology that is applied in various sectors and affects the lives of most people.

Introduction

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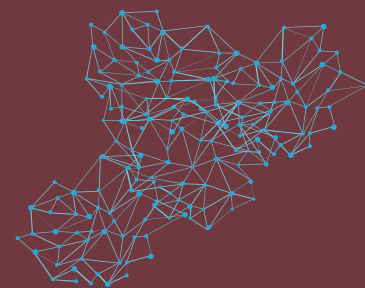
Big data can provide the raw material for training and testing AI models and algorithms, as well as for evaluating their performance and impact and it can also help to identify the needs and preferences of the users and beneficiaries of AI solutions, as well as to monitor and measure their outcomes and effects. For instance, synthetic data, which can be generated from mathematical or machine learning models without relying on data directly linked to individual citizens, has significant potential for creating new data sources. Moreover, existing large datasets owned by the private sector will be necessary if AI is to be used effectively for financial planning and monetary policy by Governments in Africa.

The purpose of this report is to explore the current state and future prospects of big data and its application uses across Africa, and to analyse the opportunities and challenges for AI development and deployment in Africa. The main research questions are:

- How ready are African countries to exploit big data?
- What are the opportunities and challenges of big data for economic growth and development in Africa?
- How can big data drive innovation and disruption in Africa and create new business models and value propositions?
- What are the social and environmental impacts of big data innovation and disruption in Africa?

How ready are African countries to exploit big data?

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The Big Data Readiness Index (BDRI)²: This concept was developed by European Data Scientists and means that the level of preparation and willingness to exploit big data which measures the big data readiness of developing countries based on six components: infrastructure, human capital, governance, innovation, demand and impact.

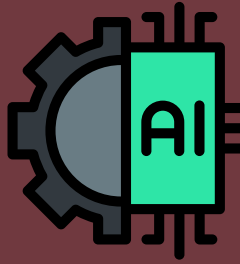
Each component is measured by a set of indicators that are derived from secondary data sources, such as World Bank indicators, Global Innovation Index indicators, and many others. The BDRI scores range from 0 to 100, with higher scores indicating higher levels of big data readiness.

Key Indicator	Countries	BDRI Score
Coastal Countries	South Africa	54.8
Coastal Countries	Kenya	47.9
Coastal Countries	Namibia	46.7
Coastal Countries	Mauritius	51.2
Landlocked Countries	Chad	14.4
Landlocked Countries	Niger	15
Landlocked Countries	CAR	15.4

The results showed that coastal countries performed better than landlocked countries in terms of big data readiness. The main factors that influenced the big data readiness performance of African countries were infrastructure availability and quality, human capital development and skills, and governance structures and policies. With the scores achieved by coastal countries, there is still room for improvement.

The readiness index is a good indicator as it shows the strengths and weaknesses of African countries in terms of big data readiness, and provides recommendations on how to improve their big data readiness performance.

What are the opportunities and challenges of big data for economic growth and development in Africa?



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Many of the issues dealt with by African businesses and governments when implementing big data projects are faced by organisations around the world, with research firm Gartner estimating that up to 85% of such projects fail to have the transformative impact leaders expect them to achieve. When forming big data programmes, businesses benefit from seeking partnerships with established organisations and institutions outside of the continent.

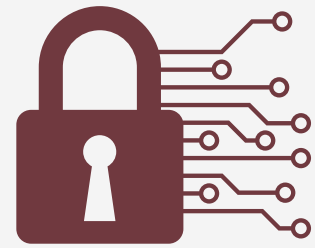
Many of the global companies in the digital sector have poured billions of dollars into research and development. If African Governments want to utilise data for development and services purposes, partnerships with the private sector need to be structured responsibly with the aim of protecting data effectively and for ethical uses. In turn, this will help Africa can take advantage of the innovation and focus on tailored execution in the region.

Big data offers various opportunities and challenges for economic growth and development in Africa. On the one hand, big data can provide valuable insights and knowledge for various sectors and domains in Africa, such as security, services, manufacturing, retail, healthcare, etc. For example, big data can be used to:

We will share some critical sectors which have critical data points that can be used to develop AI tools.

Security

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Big data can help African governments to improve security in their countries by providing data-driven solutions that can enhance or automate various tasks and processes related to security. Big data can help governments:

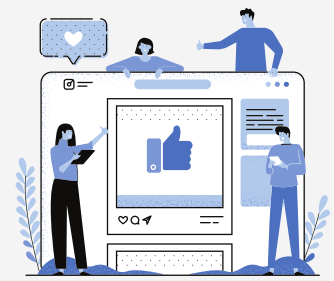
- Strengthen border control and immigration management by using data analytics and artificial intelligence to verify the identity and eligibility of travellers, as well as to detect and prevent smuggling, trafficking, and fraud.
- Prevent and combat crime and terrorism by collecting and analysing data from various sources, such as surveillance cameras, biometric systems, social media, and sensors, to monitor and predict the activities and movements of criminals and terrorists. 3
- Improve cybersecurity and resilience by using data to detect and prevent cyberattacks, such as malware, ransomware, phishing, or denial-of-service, as well as to protect critical infrastructure and information systems from unauthorised access or damage. 4
- Enhance disaster preparedness and response by using data to forecast and monitor natural hazards, such as floods, droughts, earthquakes, or epidemics, as well as to coordinate and optimise relief efforts. 5

Big data applications can be found in various domains of security in Africa, such as law enforcement, intelligence, defence, justice, and emergency management. Some examples of big data projects or initiatives in Africa are:

- The INTERPOL African Cyberthreat Assessment Report 2021, which provides key insights into cybercrime in Africa and supports coordinated action against cybercrime.
- The African Union Border Programme (AUBP), which aims to facilitate the free movement of people and goods across Africa by harmonising border management policies and practices.
- The Zindi platform, which hosts data science competitions to solve various security challenges in Africa, such as predicting conflict events, detecting fake news, or identifying wildlife poachers.
- The African Risk Capacity (ARC), which is a specialised agency of the African Union that provides weather-based insurance and early warning systems for natural disasters.

Market access

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Big data can help African businesses gain competitive advantage and access new markets and customers. As well as enhance customer service and satisfaction by understanding customer preferences, behaviour and loyalty, personalising products and services, optimising pricing and marketing strategies. Some examples of how big data can drive innovation and disruption in Africa are:

- M-Pesa: M-Pesa is a mobile money service that allows users to send and receive money through their mobile phones. M-Pesa uses big data to analyse customer transactions and behaviour and offer tailored products and services, such as loans, savings, insurance, etc. M-Pesa has disrupted the traditional banking sector and created financial inclusion for millions of unbanked people in Africa.
- Ushahidi: Ushahidi is a crowdsourcing platform that allows users to report incidents and events through various channels, such as SMS, email, and web forms to name a few.
- Nairobi-based Twiga Foods worked with Liquid Telecom to implement precision agriculture using the internet of things and enhancing it “with satellite weather data using technologies like AI and big data to improve yields and cut the cost of inputs in farming.

Logistics

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Big data can be instrumental to supply chain management by providing smart solutions thereby increasing efficiency and reducing costs by optimising routes, schedules, inventories, and deliveries based on real-time data and predictive analytics. Such data brings about more information that can be used to

- Reduce risks and uncertainties by detecting and preventing fraud, theft, damage, and errors, as well as mitigating disruptions and delays caused by external factors such as weather, traffic, or demand fluctuations. For example, Singapore uses AI to assess financial data in procurement and tender approvals to identify patterns that may indicate corrupt practices.
- Enhance sustainability and social responsibility by minimising waste, emissions, and energy consumption, as well as ensuring compliance with environmental and ethical standards. 6

Healthcare

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Africa's healthcare system is poor at best with low capital investments in infrastructure especially from a data gathering point of view. Big data can help governments to boost healthcare outcomes and quality in Africa by providing data-driven solutions that can improve the delivery, accessibility, and affordability of health services. Big data can help governments:

- Enhance disease surveillance and response by collecting and analysing data from various sources, such as health facilities, laboratories, mobile phones, social media, and sensors, to monitor and predict the spread and impact of infectious diseases, such as COVID-19, malaria, or tuberculosis. [7](#)
- Improve health system performance and efficiency by using data analytics and artificial intelligence to optimise resource allocation, supply chain management, quality assurance, and decision support for health workers and managers. For example, in the United States the Department of Health and Human Services uses AI applications to analyse procurement trends to reduce costs and improve contract structure. [8](#)
- Increase health service coverage and equity by using data to identify and address the gaps and barriers in accessing health care for different populations, such as rural areas, women, children, or marginalised groups.
- Empower patients and communities by using data to provide personalised and preventive health care, such as risk assessment, diagnosis, treatment, and follow-up, as well as to enhance health literacy, awareness, and participation. [9](#)

Big data applications can be found in various domains of health care in Africa, such as maternal and child health, mental health, chronic diseases, nutrition, environmental health, and health financing. Some examples of big data projects or initiatives in Africa are:

- The African Health Observatory Platform on Health Systems and Policy (AHOP), which provides a comprehensive repository of health data and statistics for 47 countries in the WHO African Region.
- The District Health Information Software 2 (DHIS2), which is an open-source web-based platform that supports the collection, analysis, and visualisation of routine health information for health management and planning.
- The Zipline drone delivery service, which uses data to deliver blood products, vaccines, and medications to remote areas in Rwanda and Ghana.
- The MomConnect mobile service, which uses data to provide pregnant women and new mothers with free health information and advice via SMS or WhatsApp in South Africa.

What are the opportunities leveraging big data for development?



How Big Data Enables and Constrains AI Development in Africa

Beyond the opportunities shared earlier, Global institutions have begun to deploy big data in AI for economic policy making. This informs decisions that have an impact on fiscal and monetary policy, even if not the policy itself. A research conducted by the Africa Centre for Economic Transformation, **Artificial Intelligence for Economic Policymaking** showed the various potentials in which big data can improve upon economic data modelling and decision making. Such as

- **Macro forecasting with machine learning:**

An IMF team experimented with dynamic factor models, machine learning and novel data to nowcast GDP in Europe in response to the COVID-19 crisis. They used new data from unofficial sources, such as sentiment analysis, market surveys, online search engines, and sensor data, to capture big changes in economic activity quickly.

They also used traditional data and validated their results with national statistical offices. The team compared traditional and new nowcasting methods for six European countries using datasets that included traditional and non-traditional data. The machine learning methods reduced average forecast errors by up to 75 percent. However, the models performed better in times of low volatility and failed to predict significant contractions, though they did anticipate economic downturns.

Another IMF team developed a machine learning framework to nowcast and forecast economic growth in Turkey, reducing forecast errors by 30 percent compared to traditional models. This approach can be especially useful in volatile economies where economic activity may change drastically. The team also improved the transparency and interpretability of the machine learning forecasts by revealing the contribution of each predictor to individual forecasts. The research showed that traditional forecasting models often have large errors, while machine learning models perform better because they can handle non-linear interactions among a large number of predictors more appropriately.

Moreover, machine learning models can be trained to avoid overextrapolating historical relationships. The research also showed that nowcast errors decrease significantly over time as more data is added to train the models.

Monetary Modelling

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A team at Rebuilding Macroeconomics, with experts from the Bank of England, University of California Berkeley and others, is using AI to enhance macroeconomic models for financial stability. They argue that finance, which was largely ignored in mainstream macroeconomic models before the global financial crisis, requires learning models that allow actors to adjust their actions over time based on new information and feedback. They have incorporated AI into these learning models to improve the rationality and complexity of economic decision-making.

For example, with AI, they can use big data to include a larger number of variables than usual learning models. They can also fine tune the degree of rationality of the agents in the model. This is one of the first applications of AI to a traditional adaptive learning model in macroeconomics that considers the interaction of fiscal and monetary policy variables.

With AI, they can solve models across different policy frameworks more efficiently than with traditional learning models. They plan to explore how AI agents react to fiscal and monetary shocks and how this differs from current policy analysis and recommendations. This would enable the AI model to forecast credit provision, money creation and financial stability in the face of large financial shocks.

Taxation

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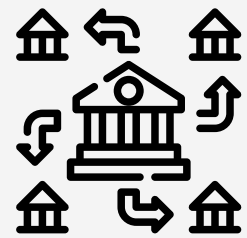


Tax policy is a key way for governments to raise funds for public needs, such as infrastructure, poverty reduction programs and many others. However, designing and implementing optimal tax policy is challenging, as it may create disincentives for taxpayers, such as tax avoidance. It is also hard to design tax policy that accounts for the different responses of various segments of the economy and population to taxation. To help address this challenge, Harvard University and Sales Force have developed an AI Economist, which is a deep reinforcement learning framework with two levels.

The AI Economist learns tax policy from observable data, without relying on data on the functions of citizens or assumptions about their actions. This reduces the bias in the tax policy design. The Harvard and Sales Force teams use simulations to test economic policies on a large scale and with a broad range of metrics. This allows them to compare millions of economic designs, while the machine behaviour is learned in parallel. The simulation approach can help inform real-world tax system design. With this approach, the AI agents can also capture potential bad behaviours, such as tax avoidance, and adjust taxable incomes over time.

Central Bank Applications

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The Center for Economic and Policy Research (CEPR) has been advocating for more AI solutions by central banks since early 2020. CEPR argues that monetary systems are very complex and dynamic, and that AI can help central banks make quick and effective decisions in times of financial crises or volatility. They call this form of AI "microprudential AI". They also argue that AI can help with macroprudential regulations by using big data to improve forecasting and communication between policymakers and financial institutions.

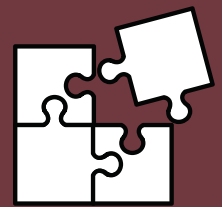
However, CEPR also outlines four key challenges: the homogenous perception of risks, the unknown-unknowns, the trust gap, and the bad actors. At the Frankfurt School of Finance and Economics, experts are researching how AI and machine learning can support monetary policy decisions. They focus on issues such as forecasting, financial risk assessment, and macroeconomic analysis. They note that the global financial crisis revealed the need for new approaches to address systemic risk and banking supervision.

They also note that central banks have access to very large data sets that can be analysed by AI to create better information and indicators for monetary policy. AI and machine learning can also help central banks measure the uncertainty in policy recommendations by using text analysis and indices.

Several central banks are using AI to support other key functions, such as nowcasting, sentiment analysis, inflation forecasting, economic growth forecasting, and policy rate setting. For example:

- The European Central Bank uses AI-enabled supervisory technology to increase the understanding of financial system early warning frameworks.
- De Nederlandsche Bank uses AI to detect liquidity issues at banking institutions.
- Banco Central de Chile uses AI to track perceived unhappiness by citizens with financial and monetary policies.
- Banco de Mexico uses sentiment analysis to analyse Twitter messages in response to economic shocks.
- Sveriges Riksbank uses machine learning to scrape the internet for key data on commodities to improve short-term inflation forecasts.
- The Reserve Bank of New Zealand uses AI to access large data sets to improve nowcasting of economic growth.
- The Bank of Indonesia uses AI for sentiment analysis to inform its policy rate. 10

Prospective challenges to AI Development



How Big Data Enables and Constrains AI Development in Africa

Big data can be deployed effectively to produce the desired goods and services required by African citizens through developed AI systems. However, big data also poses some challenges for AI development and deployment in Africa. Some of these challenges are:

Challenges	Overview
Data Quality	The quality of big data depends on various factors, such as the source, format, accuracy, completeness, timeliness, relevance, and representativeness of the data. Poor quality data can lead to biased or inaccurate AI results or recommendations, which can have negative consequences for individuals or groups.
Data Ownership	The ownership of big data refers to who has the right to collect, store, access, use, share, or sell the data. Data ownership can raise ethical and legal questions about who benefits from or bears the risks of big data and AI applications. Data ownership can also affect the availability and accessibility of big data for different stakeholders.
Data Privacy	The privacy of big data refers to the protection of personal or sensitive information that can be derived from or linked to the data. Data privacy can be compromised by unauthorised or inappropriate access or use of big data by third parties or by Governments themselves. Data privacy can also be affected by the consent or awareness of the data subjects or providers regarding how their data is collected or used. For example, big data may expose individuals to identity theft, discrimination, and surveillance just to name a few.
Data Security	The security of big data refers to the prevention of loss, damage, theft, or corruption of the data. Data security can be threatened by natural disasters as well.
Human resource scarcity	Big data requires skilled and qualified human resources to manage and analyse the data effectively. However, there is a shortage of such human resources in Africa, especially in terms of data scientists, engineers, analysts, etc.
Lack of institutional governance	Big data requires appropriate institutional governance to ensure the ethical and responsible use of data. However, there is a lack of such governance in Africa, especially in terms of legal frameworks, regulatory bodies, standards, policies, to name a few. In practice, monetising data can be problematic due to a patchwork of data storage and privacy laws that limit the transport of personal data outside of national borders. International social media giants such as Facebook are increasingly under the microscope for how they gather and exploit customer data. Many African countries currently only have rudimentary laws governing the gathering and exploitation of citizen and customer data.

What are the social & environmental impacts of big data disruption in Africa?



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Big data disruption in Africa can have a negative impact on the social and environmental aspects of development. Here are some of the possible impacts:

- Big data disruption can also pose significant challenges and risks for human rights, ethics, governance and inclusion in Africa. For example, big data can threaten the privacy, security, ownership and rights of data subjects and producers, especially in the absence of adequate data governance and regulation frameworks. Big data can also create or exacerbate digital divides, social and economic inequalities, and data colonialism. Big data can also undermine democratic institutions and processes by enabling misinformation, manipulation and interference.
- Big data disruption can also have negative environmental impacts in Africa. For example, big data can increase the demand for energy and infrastructure, which can generate more greenhouse gas emissions and waste. Big data can also enable or facilitate activities that harm the environment, such as illegal mining, logging or poaching.

Recommendations

How Big Data Enables and Constrains AI Development in Africa



In the AI race, big data is crucial to developing products that will meet the needs of Africans. But would require a multi-stakeholder approach to define the road map for implementation and get the buy-in of African Governments.

There is a gap in digital leadership in Africa. Most stakeholders are technical experts, but they need more support from political leaders who understand and prioritise frontier technologies. One of the key issues with investing in Africa and in this case the technological sector, is the multipolarity of the policies unlike the European Union which has set rules or guidelines on policy emanating from Brussels. For example, the 2014 Malabo Convention on Cybersecurity and Personal Data Protection called for the adoption of a common framework on the protection of data. But as of May 2020, only 10 countries had ratified the convention, and only 14 have signed it. The convention needs at least 15 ratifications to enter into force. Some of the challenges that hinder the ratification and adoption of the convention include lack of awareness, political will, technical capacity, data sovereignty, little understanding of the technicalities regarding data generated from technologies and resources. ¹¹

Currently, most rules governing the protection of personal data are a patchwork, with some countries offering little to no protection policy while others have extensive digital governance frameworks. Despite this, firms will be required to operate with the distinct data protection and privacy policies of more than 30 countries. It follows that compliance costs will likely rise as African countries begin strictly enforcing their data protection and privacy standards.

The utilisation of big data to provide unique AI products in Africa may be affected by the diversity of data protection and privacy policies. This impacts investments interest in developing unique tools or assets as it may create challenges for firms that want to access, process, and share data across different countries and regions, as they will have to comply with different standards and regulations. This may increase their costs, reduce their efficiency, and limit their innovation potential.

Recommendations

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It is then critical for the digital leadership by the African Union to implement its AU Digital Transformation Strategy through its technical body, African Union Development Agency (AUDA-NEPAD). AUDA-NEPAD is also leading the development of a continental strategy for AI, but the effort is more focused on identifying emerging technologies to support Africa's economic growth. The **AU High-Level Panel on Emerging Technologies** convened a group of experts in May 2022 to discuss a continental strategy for AI which was launched in the first quarter of 2023. The panel plans to issue guidelines to African governments on AI. [12](#)

The AU needs to establish the institutional governance for big data by creating and implementing legal frameworks, regulatory bodies, standards, policies, to name a few. This is to ensure the ethical and responsible use of data. There is also a need for regional institutions like the AfDB and the Regional economic communities/blocs to drive policy issues related to artificial intelligence and other technologies.

Developing the African human capital is critical for big data development and utilisation for AI systems. The AU Commission has highlighted this need but African Governments are burdened by the inflationary crisis and debt leaving little room for investment. This is where the PPP initiatives become instrumental and relieving Governments of the heavy burden.

This educational capacity should be done from the ground up and not through short skill programmes like workshops but integrated in the fabric of secondary and tertiary institutions. For example, in Kigali, the capital of Rwanda, the African Institute for Mathematical Scientists (AIMS) is running a one-year Masters degree programme in partnership with Facebook and Google to create the next generation of tech leaders. The degree is the first Masters programme of its kind on the continent. Talented scientists and innovators drawn from various African countries are being trained in machine learning, a type of AI. [13](#)

Conclusion

How Big Data Enables and Constrains AI Development in Africa.



The convergence of big data and AI holds immense potential for Africa's development across sectors such as healthcare, agriculture, finance, smart cities, and education. By addressing the challenges of data quality, infrastructure, skills gap, and ethics, Africa can unlock the transformative power of big data and AI to drive innovation, economic growth, and social progress. Embracing this technological revolution, Africa can leapfrog into an AI-powered future, empowering its people and shaping a prosperous continent.

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How Big Data Enables and Constrains AI Development in Africa

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