AUDA-NEPAD White Paper: Regulation and Responsible Adoption of AI in Africa Towards Achievement of AU Agenda 2063

Draft 1.0

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ABOUT THE AU AND AUDA-NEPAD

THE AFRICAN UNION (AU)

The African Union (AU) is a continental body consisting of all 55 countries on the African continent. It was established on 26th May 2001 in Addis Ababa, Ethiopia, and launched on 9th July 2002 in South Africa, to replace the Organisation of African Unity (OAU). The AU was established following the 9th of September 1999 Sirte Declaration of the Heads of State and Governments of the Organisation of the African Unity (OAU). The most important decisions of the AU are made by the Assembly of the African Union, a semi-annual meeting of the Heads of State and Governments of its member states. The AU's Secretariat, the African Union Commission, is based in Addis Ababa, Ethiopia. The AU is based on a common vision of a united and strong Africa and on the need to build a partnership between governments and all segments of civil society, in particular women, youth, and the private sector, to strengthen solidarity and cohesion amongst the peoples of Africa. As a continental organization, it focuses on the promotion of peace, security, and stability. The development work of the AU is guided by the AU Agenda 2063, which is a 50-year plan to harness Africa's comparative advantage to deliver on the vision of "The Africa We Want".

THE AFRICAN UNION DEVELOPMENT AGENCY (AUDA-NEPAD)

The African Union Development Agency (AUDA-NEPAD) is a strategic framework for pan-African socio-economic development. AUDA-NEPAD is spearheaded by African leaders to address critical challenges facing the continent including poverty, development, and Africa's international marginalization. AUDA-NEPAD provides unique opportunities for African countries to take full control of their development agendas, work more closely together and cooperate more effectively with international partners.

AUDA-NEPAD was preceded by the NEPAD Planning and Coordinating Agency (AUDA-NEPAD) which was established in February 2010 as an outcome of the integration of NEPAD into the AU's structures and processes. AUDA-NEPAD manages several programmes and projects in four main investment portfolios, namely Natural Resources Governance; Youth and Skills Development; Regional Integration; Infrastructure and Trade; and Industrialization, Science, Technology, and Innovation. About the AU and AUDA-NEPAD

THE AFRICAN UNION HIGH-LEVEL PANEL ON EMERGING TECHNOLOGIES (APET)

The initial Specialized Technical Committee on Education, Science, and Technology (STC-ESTI) called upon the AU Commission and AUDA-NEPAD to guide Member States and RECs regarding technology prospecting, including the necessary regulatory and ethical requirements for Africa to benefit from emerging technologies. The committee mandated the NEPAD Agency to establish a system that would facilitate expert input on technology development, acquisition, and deployment to drive socio-economic growth.

In December 2016, the Chairperson of the African Union Commission, H.E. Dr Nkosazana Dlamini Zuma, appointed a group of ten experts from diverse backgrounds to serve on the African Union High-Level Panel on Emerging Technologies (APET). This panel's primary objective was to harness existing and emerging technologies for Africa's economic advancement. The panel members, who represent a variety of professional fields, provide evidence-based analyses and recommendations to guide policy decisions at continental, regional, and national levels about the utilisation of existing and emerging technologies.

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Currently chaired by Prof Yaye Kène Gassama, the High-Level Panel comprises ten leading experts who represent gender and geographical diversity. The panel includes esteemed individuals such as Prof Roseanne Diab, Prof Berhanu Abegaz, Prof Francine Ntoumi, Prof Abdallah Daar, Dr Rachel Chikwamba, Prof Dr Shireen Assem, Prof Karim Maredia, Prof Abubakar Sani Sambo, and Dr William Wasswa. Apart from advising the African Union and its Member States on harnessing innovations and emerging technologies for economic development, the panel also develops strategies, policies, and institutional arrangements to promote and sustain common regulatory approaches for the application of emerging technologies in Africa.

AU HIGH-LEVEL PANEL ON EMERGING TECHNOLOGIES (APET)

White Paper: Regulation and Responsible Adoption of AI for Africa Towards Achievement of AU Agenda 2063

This Continental Strategy is the product of the African Union High-Level Panel on Emerging Technologies (APET). It is part of a larger effort by the African Union Development Agency (AUDA-NEPAD) to promote knowledge and learning, share ideas and experiences, provide open access to its research, and contribute to development policy and programme interventions. The knowledge featured in the Continental Strategy is considered to have a bearing on the mission of AUDA-NEPAD and its strategic objectives, as aligned to the AU Agenda 2063, which is a Pan-African Vision of an integrated, prosperous, and peaceful Africa, driven by its citizens, representing a dynamic force in the international arena.

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EXECUTIVE SUMMARY

Artificial intelligence (AI) holds immense value in developing Africa's socioeconomic effectiveness and bolstering the harnessing of 4th industrial revolution (4IR) technologies. By leveraging AI, Africa can enhance productivity, optimise resource allocation, and drive innovation across various economic sectors. AI-powered solutions can streamline processes, automate tedious tasks, and improve decision-making, leading to increased efficiency and competitiveness. Additionally, AI can facilitate access to vital services in areas such as healthcare, agriculture, and education, improving outcomes, and ensuring inclusivity. By embracing AI, African countries can position the continent as a hub for technological advancement, attracting investments, fostering entrepreneurship, and creating job opportunities. Ultimately, AI has the potential to empower Africa to overcome developmental challenges, bridge digital divides, and achieve sustainable growth, driving socio-economic transformation and positioning the continent at the forefront of the global digital revolution.

The continent, however, faces various challenges in harnessing AI-based technologies, including high costs associated with infrastructure installation, capacity strengthening, and skills expansion. The capital investments required for creating AI systems that simulate human intelligence are substantial and demand time and resources. Additionally, the continuous need for the latest hardware and software poses further financial burdens. However, the cost of avoiding these investments would be even higher in the long run. To address these challenges, African countries should focus on human capital development, infrastructure, and data foundations, creating enabling environments, improving AI economy, and sustainable partnerships.

Governance of AI is an important consideration in incorporating ethical principles and legislative instruments to ensure responsible AI development and usage. African countries ought to adopt national AI strategies that define priorities across economic sectors, thereby enabling effective governance and regulation. Data safety, security, and protection should be prioritised, and mechanisms for auditing and explaining AI systems established. Incentives such as tax cuts and simplified business administration could be provided to make AI more accessible to small-to-medium enterprises (SMEs) and drive local innovation.

For Africa to address the challenge of human capital development, knowledge sharing, and fostering an innovative AI environment, there is a need to invest in the workforce and strengthen AI platforms for knowledge development and dissemination. Therefore, to adapt to the changing workplace and take advantage of digital tools such as AI effectively, the current and future workforce need to be equipped with basic to intermediate digital skills. African governments are encouraged to collaborate with industry and academia to establish systems for training the workforce in dominant regional languages. Furthermore, countries can strengthen human capital with intermediate to advanced AI skills by providing training through open-source online platforms in multiple African languages.

An Innovation and Skills Plan is crucial for driving transformation in African businesses by offering a suit of programmes. This can target critical stages of firm growth and provide business innovation support, with the plan addressing challenges and opportunities for businesses in Africa. For example, the African Union can establish an African Artificial Intelligence Research Institute (AAIRI) that can facilitate AI knowledge creation, quality human resource development, and intellectual property creation. The institute could work across multiple countries, physically and virtually in addressing legislation, human rights, algorithmic transparency, fairness, privacy, and data protection. Furthermore, an African Digital Entrepreneurial Institute (ADEI) could also be established to support AI and digital-related entrepreneurial activities across the continent. By creating a conducive environment for small, medium, and micro enterprises (SMMEs) to thrive, the institute would contribute to the economy and drive digital innovation.

Africa can also strengthen its AI capabilities and foster innovation by reinforcing data infrastructure for AI. This can be accomplished by creating market demand for local data centres. By fostering collaboration with data service providers, start-up companies, researchers, and public and private sectors, governments can stimulate market demand for the use of local data centres on the continent.

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Furthermore, national ministries responsible for education, science, technology, and innovation could stimulate students' interest in data careers by incorporating data literacy and technical data competency courses into the academic curriculum. To supplement these efforts, support such as scholarships and bursaries could be provided for studying data management, and businesses should be encouraged to hire local data practitioners through internship and full-time employment opportunities.

To strengthen skills development in data governance, funds could be allocated to local universities for research and acquiring modern tools for data management. Reliable connectivity between universities should be supported to facilitate data knowledge sharing and collaboration. African countries should develop comprehensive national data strategies that address accessibility, data collection, storage, sharing, and analysis and commercialization. Promoting open data platforms and APIs, as well as establishing data marketplaces will facilitate access to data for AI development.

Collaboration is an important consideration as African countries collaborate with the private sector to develop affordable and accessible digital infrastructure. This includes improving internet access, increasing cloud service availability, and investing in computing resources. In addition, African governments should make a conscious effort to democratise AI by facilitating its introduction into the private sector, including small businesses. AI policies should focus on reducing barriers to AI adoption and ensuring that the technology is available to all through the production of AI-related digital public goods.

Investment in education and skills development programmes is needed to mitigate any potential negative effects of AI on the labour market. Countries are urged to prioritise AI teaching and training at all levels of the education system. This includes providing training and awareness programmes to develop the skills and expertise needed for AI system development. Lifelong learning opportunities should be promoted, and innovative funding mechanisms explored to support human capital development and research. Additionally, to attract and retain AI talent, African countries could offer competitive compensation packages, opportunities for career growth, and a supportive environment for innovation and creativity.

African countries should develop AI policies, regulations, and ethical frameworks that promote data privacy, security, transparency, and accountability. Robust data protection laws could be established, and public awareness and participation in AI policymaking promoted. Countries could also incentivise investment in AI research and development, provide financial incentives for AI start-ups, and promote investment in AI infrastructure such as broadband internet and local data centres.

To support the growth of AI start-ups in Africa, targeted investment and funding mechanisms should be established. One recommendation is the creation of the African Union AI Fund, with an estimated budget of US$100 million over five years. This fund would allocate 70% of its budget to early-stage and scale-up AI start-up companies, while the remaining 30% would be dedicated to AI research in start-up companies and academic institutions to support -market fit, deployment, scale-up, and growth stages of AI ventures in Africa. As such, case studies such as the Pan-Canadian AI Strategy, the European Union's Digital Europe Programme, France's €1.5 billion investment in AI, and China's Next Generation Artificial Intelligence Development Plan can provide valuable insights. These initiatives have led to increased investment in AI research and development, expanded talent pools, and fostered collaboration between stakeholders.

AUDA-NEPAD underscores the importance of targeted funding and investment mechanisms to support the growth of AI start-up companies in Africa. By providing financial support, fostering collaboration, and addressing challenges, African countries can create vibrant and competitive AI ecosystems, attract top talent, and drive innovation in various sectors such as healthcare, education, manufacturing, and transportation.

The panel opines that to build and strengthen sustainable partnerships in AI, African countries should establish effective communication strategies that highlight the value of AI on both continental and global scales. This entails creating a versatile digital and physical identity for AI in Africa, and empowering individuals and communities with advanced technologies. Thus, by leveraging this

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identity, African countries can unlock the potential of AI to drive innovation, enhance productivity, address societal challenges, and create new economic opportunities.

Establishing a robust legal framework and advisory system is, essential to facilitate partnerships, standardize modes of communication, and protect intellectual property rights. Furthermore, effective communication strategies and outreach programmes should be implemented to publicize existing AI models and promote the widespread adoption of AI solutions across various sectors.

To ensure the effective implementation and integration of AI partnerships in Africa's socioeconomic landscape, it is recommended that the African Union (AU)or AUDA-NEPAD establishes a Strategy Committee for AI Partnerships and the Economy, to comprise of experts to be responsible for monitoring and evaluating AI activities and their impact across the continent. The committee would focus on fostering partnerships in the AI sector and encouraging collaborations between local and international stakeholders to leverage expertise and resources. Additionally, the Strategy Committee would ensure that AI initiatives are closely integrated into African countries' socioeconomic development plans, aiming to drive inclusive growth, job creation, and improved living standards.

Implementing the policy recommendations outlined in this AU Artificial Intelligence Continental Strategy for Africa can enable countries to establish a strong foothold in the field of AI development. Thus, AUDA-NEPAD supports a regulatory and investment-oriented approach with the twin objective of promoting the uptake of AI and of addressing the risks associated with certain uses of this new technology. The purpose of this White Paper is to set out policy options on how to achieve these objectives. AUDA-NEPAD invites Member States, AU organs and all stakeholders, including industry, social partners, civil society organisations, researchers, the public in general and any interested party, to implement the recommendations in the White Paper and to contribute to the Commission's future decision-making in this domain.

By prioritising robust communication strategies, African countries can effectively showcase the value proposition of AI on both continental and global scales. This, in turn, would drive innovation, enhance productivity, and create new opportunities for economic growth and development across the continent. Additionally, by focusing on data strategies, African countries can leverage partnerships and establish a solid foundation for the responsible implementation of AI technologies, promoting innovation and attracting further investment. By adopting strategic funding and collaborative institutions and integrating AI into Africa's socioeconomic development plans, the continent can harness the potential of the technology to drive inclusive growth, job creation, and improved living standards, positioning itself as a leader in AI development and reaping the benefits.

The White Paper outlines policy options on how to achieve the dual objectives of promoting the uptake of artificial intelligence (AI) and addressing the risks associated with certain uses of this new technology.

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DEFINITIONS AND NOMENCLATURE

4IR	Fourth Industrial Revolution
AAIRI	African AI Research Institute
ACB	African Central Bank
ACSA	African Union Artificial Intelligence Continental Strategy for Africa
ADEI	African Digital Entrepreneurial Institute
ADS	Automated Decision Systems
AfCFTA	African Continental Free Trade Area
AI	Artificial Intelligence
AI4D Africa	Artificial Intelligence for Development in Africa
AIB	African Investment Bank
AIDA	Accelerated Industrial Development for Africa
AIMS	African Institute for Mathematical Sciences
AMF	African Monetary Fund
AMV	African Mining Vision
ANPR	Agence Nationale de la Promotion de la Recherche Scientifique
APET	African Union High-Level Panel on Emerging Technologies
APIs	Application Programming Interfaces
AU	African Union
AUCSEG	African Union's Cybersecurity Expert Group
AUFIs	African Union Financial Institutions
BEIS	Department for Business, Energy & Industrial Strategy
BIAT	Boosting Intra-African Trade
CAADP	Comprehensive African Agricultural Development Programme
CAIR	Centre for Artificial Intelligence Research
CFAIR	Centre for AI and Robotics
CIFAR	Canadian Institute for Advanced Research
CIPIT	Centre for Intellectual Property and Information Technology Law
DCMS	Department for Digital, Culture, Media, and Sport
EAC	East African Community
ECOWAS	Economic Community of West African States
EU	European Union
FAIR	Findable, Accessible, Interoperable, and Reusable
FMP	Free Movement of Persons
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
HITL	Human-In-The-Loop
ICT	Information and Communication Technology
IDC	International Data Corporation

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IDRC	International Development Research Centre
IP	Intellectual Property
ISAGO	Implementation and Self-Assessment Guide for Organisations
ITI	Information Technology Institute
KENET	Kenya Education Network
MAIS	Mauritius Artificial Intelligence Strategy
ML	Machine Learning
NLP	Natural Language Processing
ODeL	Open, Distance and eLearning
OECD	Organisation for Economic Co-operation and Development
PIDA	Programme for Infrastructural Development in Africa
PwC	Price Waterhouse Coopers
PWD	Persons With Disabilities
R&D	Research and Development
SAATM	Single African Air Transport Market
SADC	Southern African Development Community
SDAIA	Saudi Data and Artificial Intelligence Authority
SIDA	Swedish International Development Cooperation Agency
SMMEs	Small, Medium, and Micro Enterprises
STEM	Science, Technology, Engineering, and Mathematics
STI	Science Technology and Innovation
STISA-2024	Science, Technology, and Innovation Strategy for Africa
TD	Training Data
UN SDGs	United Nations Sustainable Development Goals
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
UNIDO	United Nations Industrial Development Organisation
WHO	World Health Organisation
WIL	Work-Integrated Learning
WiMLDS	Women in Machine Learning and Data Science
WIPO	World Intellectual Property Organisation

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1 INTRODUCTION

1.1 BACKGROUND

As digital technology becomes a more central part of every aspect of people's lives, people should be able to trust it. Trustworthiness is also a prerequisite for its uptake. This is a chance for Africa, given its strong attachment to values and the rule of law as well as its proven capacity to build safe, reliable, and sophisticated products and harness emerging technologies for the socio-economic development of African countries. This White Paper is a publication of the African Union Development Agency – NEPAD in collaboration with the African Union High Level Panel on Emerging Technologies (APET). Thus, their roles and opinions are used interchangeably in this document.

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to process information and function similarly to human beings. In mimicking humans' actions, AI-based systems are exhibiting traits that are associated with a human mind such as learning and problem-solving. AI is characterised by its ability to rationalize and take actions that have the best probability of accomplishing a specific goal. Machine learning (ML), as a subset of AI, deals with computer programmes that can automatically learn from and adapt to new data without being assisted by humans. On the other hand, deep learning, as a subset of AI, involves techniques that can enable automatic learning by absorbing quantities of unstructured data such as text, images, and videos.

AI is a collection of technologies that combine data, algorithms, and computing power. Advances in computing and the increasing availability of data are therefore key drivers of the current upsurge of AI. AI also deals with the simulation and approximation of human intelligence in machines and these systems include computer-enhanced learning, reasoning, and perception. To this end, AI is utilized in various industrial and economic applications such as education, transportation, agriculture, finance, mining, and healthcare.

AI is evolving to profit and advance many industrial activities. This is enabled by the fact that AI systems are supported by cross-disciplinary approaches that are based on mathematics, computer science, linguistics, psychology, and more. In such cases, algorithms are applied in AI to undertake simple and complex tasks, which enables AI to be applied to many economic sectors and industries such as dispensing medication, dispersing treatments tailored to specific patients, and assisting in surgical procedures in the operating room. Furthermore, AI has applications in the financial industry to monitor banking and finance activities such as unusual debit card usage and large account deposits—all of which can assess fraudulent activities. Applications for AI can also streamline and facilitate trading by making the supply, demand, and pricing of securities easier to assess, estimate, and appraise.

AI could be categorized into reactive AI, limited memory AI, theory-of-mind AI, and self-aware AI. Reactive AI utilises algorithms to augment outputs based on a set of inputs. For example, chess-playing AI systems are reactive systems that optimize the best strategy to win the game. Reactive AI is more inclined to be static and unable to learn and adapt to novel situations. Consequently, reactive AI tends to generate the same output when provided with identical inputs. On the other hand, with limited memory, AI can adapt to previous experiences and subsequently update the system based on new observations and data. As such, the frequency of updating is limited, and the length of memory is relatively short. For example, autonomous vehicles can read the road and adjust to novel situations, and even learn from past experiences.

The theory-of-mind AI are fully adaptive and possesses the extensive capability to learn and retain past experiences. Fundamentally, these types of AI include advanced chat-bots that could pass the Turing Test and make a user believe that the AI was a human being. However, these theory-in-mind AI types are not self-aware. On the other hand, self-aware AI can become sentient and aware of its existence. This type of AI does not exist now and remains fictional.

Currently, AI is being used across a range of economic applications of varying levels of sophistication. For example, recommendation algorithms such as chatbots appear on websites and in the form of smart

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speakers such as Alexa and Siri. Furthermore, AI is utilised to make weather predictions, and financial forecasting, streamline production processes and undertake redundant cognitive labour such as tax accounting and editing. AI could also be utilised to play games, operate autonomous vehicles, and process language, among other things. For example, AI is utilised in healthcare to assist in diagnostics. Particularly, AI can effectively identify small anomalies in scans and can triangulate diagnoses from a patient's symptoms and vitals. Additionally, AI can classify patients, monitor, and track medical records, and manage health insurance claims. In future, AI innovations may include AI-assisted robotic surgery, virtual nurses or doctors, and collaborative clinical judgment.

Africa can combine its technological and industrial strengths with a high-quality digital infrastructure and a regulatory framework based on its fundamental values to become a global leader in innovation in the data economy and its applications as set out in the AU-AI Continental Strategy. On that basis, it can develop an AI ecosystem that brings the benefits of the technology to the entire African society and economy. Furthermore, the impact of AI systems should be considered not only from an individual perspective, but also from the perspective of society as a whole. The use of AI systems can have a significant role in achieving the AU Agenda 2063 and the Sustainable Development Goals, and in supporting the democratic process and social rights.

Given the increasing importance of AI, the environmental impact of AI systems needs to be duly considered throughout their lifecycle and across the entire supply chain, e.g., as regards resource usage for the training of algorithms and the storage of data. A common African approach to AI is necessary to reach sufficient scale and avoid the fragmentation of the single market. This AU White Paper presents policy options to enable a trustworthy and secure development of AI on the African continent, in full respect of the values and rights of its citizens.

The AU-AI continental strategy for data, which accompanies this White Paper, aims to enable Africa to become an attractive, secure, and dynamic data-agile economy – empowering African countries with data to improve decisions and better the lives of all its citizens. The White Paper sets out a number of policy measures, including mobilising private and public investments, needed to achieve this goal. Finally, the implications of AI, Internet of Things and other digital technologies for safety and liability legislation are analysed in the Commission Report accompanying this White Paper.

1.2 AI FOR ECONOMIC DEVELOPMENT AND GROWTH

Artificial Intelligence (AI) is rapidly becoming an epicentre of economic development and growth, with significant applications in commerce, education, health, public service delivery, social media and communications, governance, agriculture, and manufacturing, among other economic activities. In Africa, AI is significantly contributing towards accomplishing the African Union's Agenda 2063 and United Nations Sustainable Development Goals (SDGs) through implementation of the Science, Technology, and Innovation Strategy for Africa (STISA-2024). Fundamentally, AI is progressively being adopted and implemented to target socioeconomic development, enhance food production, eradicate poverty, and address climate change.

Unfortunately, most African countries have limited or no AI comprehensive policy frameworks to encourage the adoption and implementation of responsible AI, regulate AI-enabled business models, strengthen AI-driven socioeconomic development and growth, and effectively promote high-quality African data collection, processing, and interpretation. As such, limited African countries have outlined comprehensive Remarkably, the Government AI Readiness Index 2021 ranked Africa as one of the regions with the lowest level of readiness for AI adoption, with an overall score of 3.49 out of 10, ranking fifth out of the six regions assessed.

According to the Government of AI Readiness Index 2022, on a scale of 100 points, the average score for North Africa is 38.59 points, whereas, for sub-Saharan Africa, it is 29.38 points. Both regions are below the global average score of 44.61 points. Furthermore, according to a report by Oxford Insights, Mauritius is ranked first in the African countries' index for AI readiness in the public sector. With a

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score of 53.38 points, it is ranked 57th globally. The index ranks countries based on 39 indicators across three pillars, namely, government, technology sector, and data and infrastructure.[1] Egypt comes second in Africa, followed by South Africa, Tunisia, Morocco, Kenya, Rwanda, Seychelles, and Nigeria. None of the African countries obtains good scores in the technological sector pillar. On the other hand, high-income countries with strong AI strategies and investments dominate the global rankings, with the United States of America ranking first. The USA is followed by Singapore, the United Kingdom, Finland[2], Canada, South Korea, France, Australia, Japan, and the Netherlands.[3]

The report also highlighted that several African countries are in the lowest range of the rankings, indicating that they face significant challenges in adopting and implementing AI solutions. These challenges include limited access to digital infrastructure, low levels of digital skills, and inadequate regulatory frameworks for AI. However, the report noted that there are several positive developments in the region, such as the growth of AI start-up companies and the increasing focus on AI in national development agendas.

The Centre for Intellectual Property and Information Technology Law (CIPIT) at the Strathmore Law School in Kenya have reported about 213 AI-enabled applications being developed in, or for utilisation in, Africa in about 33 sectors in 2021. These AI-enabled applications were especially developed and applied in corporate services, health, agriculture, business intelligence, and education. Within these AI applications, data analytics, chatbots, and decision support are the predominant technologies being developed and implemented as Africa's frontier technology for development.

The African Union High-Level Panel on Emerging Technologies (APET) considers AI technology the frontier for socioeconomic development, especially during the 4th Industrial Revolution. As such, African countries have the potential to enhance the policy and enabling environment essential for leveraging AI opportunities. This can be achieved by eliminating regulatory and investment constraints and accurately assessing the risks involved in applying AI-enabled policy frameworks, which can inform economic policymaking and planning for economic development and growth. Thus, the AUDA-NEPAD White Paper proposes the necessary measures that African countries should adopt to potentially facilitate inclusive and sustainable AI-enabled socioeconomic transformation.

1.3 THE AFRICAN UNION'S AGENDA 2063: AFRICA WE WANT

The African Union's (AU) Agenda 2063: "*The Africa We Want*" is Africa's blueprint and master plan that was established to transform Africa's economy to be competitive on the global stage. Agenda 2063 is the continent's blueprint and master plan for transforming Africa into the global powerhouse of the future. It is the concrete manifestation of how the continent intends to achieve this goal within a 50-year period. The First Ten-Year Implementation Plan of Agenda 2063, spanning from 2014 to 2023, outlines a set of goals, priority areas and targets that the continent aims to achieve at national, regional, and continental levels.

Agenda 2063 guides individual and collective actions towards the African Union's vision of "an integrated, prosperous and peaceful Africa; an Africa driven and managed by its own citizen; and representing a dynamic force in the international arena". The continental development agenda was adopted by African heads of state and government during the golden jubilee celebrations of the formation of the Organisation of African Unity (OAU) / African Union in May 2013, as an affirmation of their commitment to support Africa's new path for attaining inclusive and sustainable economic growth and development. It seeks to deliver on a set of seven aspirations each with its own set of goals which, if achieved, will move Africa closer to achieving "The Africa We Want".

[1] https://extensia-ltd.com/2023/01/17/ranking-of-african-countries-best-prepared-to-adopt-artificial-intelligence-oxford-insights/#:~:text=The%20%E2%80%9CGovernment%20AI%20Readiness%20Index,%2C%20Rwanda%2C%20Seychelles%20and%20Nigeria.
[2] Finland 2017, AI from Finland, https://toolbox.finland.fi/wp-content/uploads/sites/2/2021/01/bf_ai_from_finland_web.pdf
[3] United Kingdom 2021, National AI Strategy, https://www.pdpc.gov.sg/-/media/files/pdpc/pdf-files/resource-for-organisation/ai/sgmodelaigovframework2.ashx

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Goal 2 of Agenda 2063 which speaks to a Well-Educated Citizens and Skills Revolution underpinned by Science, Technology and Innovation is of relevance to this White paper. This continent's strategic framework is delivering on inclusive and sustainable STI-based development to drive a pan-African drive for unity, self-determination, freedom, progress, and collective prosperity pursued under Pan-Africanism and African Renaissance. In addition, the AU's Agenda 2063 is helping African leaders to refocus and prioritise Africa's economic agenda to enhance the continent's economic competitiveness. This can also help prioritise inclusive socioeconomic development, continental and regional integration, democratic governance and peace and security amongst other issues to reposition Africa's global impact.

AU Member States have put in place structures and systems for domestication, implementation and monitoring of Agenda 2063 and other development frameworks such as the SDGs. In many countries, inter-ministerial and multistakeholder coordination and steering committees are established to coordinate the implementation and reporting on Agenda 2063, with the Ministries responsible for planning, finance and economic development designated as the coordinating agencies.

AU's Agenda 2063 has enabled African countries to formulate key flagship programmes that can potentially bolster Africa's economic growth and development and facilitate the rapid transformation of Africa. These flagship programmes are focused on improving Africa's infrastructure, education, science, technology, arts and culture, and peace and security initiatives. This includes an integrated high-speed train network to connect all African capitals and commercial centres. This is aimed at facilitating the movement of goods, factor services, and people timely and cost-effectively. Furthermore, the development of a continental commodities strategy is substantively enabling Africa's capacity to value addition to extract higher dividends from commodities. This is also enabling the integration of Africa's commodities into the global value chains and promoting vertical and horizontal diversification fastened in value addition and local content development.

AUDA-NEPAD realises that emerging technologies using AI as the epicentre can enable African countries to accomplish these ambitions. This can ensure that AU's Agenda 2063 delivers quantitative and qualitative transformational outcomes for Africa's people. This is also presenting Africa with economic opportunities in practically all economic sectors. As such, the continent's youthful population can benefit from the enormous opportunities in this digital era. Hence, Africa should formulate digitally enabled socioeconomic development and growth. This is because digital transformation can promote innovative, inclusive, and sustainable growth.

Successful implementation of Agenda 2063 will require increased public awareness of the content and relevance of the continental development agenda to the local contexts, thereby highlighting synergies and complementarities between the continental, regional and national development agendas. Emphasis should be placed on ensuring that the continental agenda is firmly embedded in national and sub-national level planning and implementation processes and instruments. Member States should anchor Agenda 2063 within existing country and regional institutional mechanisms with designated focal points for improved domestication, coordination, implementation and reporting on Agenda 2063.

1.4 THE SCIENCE, TECHNOLOGY, AND INNOVATION STRATEGY FOR AFRICA (STISA-2014-2024)

In 2014, Member States of the AU adopted the Science, Technology, and Innovation Strategy for Africa (STISA-2024) that provides overall policy directions and priority areas for investment in STI. STISA-2024 is the overarching policy and programmatic framework with strategic measures for promoting STI to attain Africa's aspiration in Agenda 2063 and the global Sustainable Development Goals (SDGs). Its mission is to "Accelerate Africa's transition to an innovation-led, Knowledge-based Economy" by: (a) "improving STI readiness in Africa in terms of infrastructure, professional and technical competence, and entrepreneurial capacity"; and "implementing specific policies and programs in science, technology

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and innovation that address societal needs in a holistic and sustainable way." The strategy articulates six priorities and interrelated specific objectives.

The Science, Technology, and Innovation Strategy for Africa (STISA-2014-2024) is enabling Africa's socioeconomic development and growth. This is being accomplished in critical economic sectors such as agriculture, energy, environment, health, infrastructure development, mining, security, and water management, among others. The strategy envisions an innovative and transformational Africa through a knowledge-based economy. Furthermore, STISA-2024 is prioritising the eradication of hunger and accomplishing food security, prevention and control of diseases, communication through physical and intellectual mobility, protection of Africa's space, societal peace, stability, harmony, and wealth creation.

STISA 2024 further defines four mutually reinforcing pillars which are prerequisite conditions for its success. These pillars are building and/or upgrading research infrastructures; enhancing professional and technical competencies; promoting entrepreneurship and innovation; and providing an enabling environment for STI development in the African continent. Continental, regional, and national programmes will be designed, implemented, and synchronized to ensure that their strategic orientations and pillars are mutually reinforcing, and achieve the envisaged developmental impact as effectively as possible.

The implementation of STISA-2024 takes place at three levels. At national level, Member States are urged to incorporate this strategy into their National Development Plans. At regional level, Regional Economic Communities (RECs), regional research institutions, networks and partners leverage the strategy in designing and coordinating initiatives. At continental level, the African Union Commission (AUC), AUDA-NEPAD and their partners advocate and create awareness, mobilize necessary institutional, human, and financial resources, track progress and monitor implementation.

Continental, regional, and national targets and indicators are defined to facilitate comparability of data and regular Monitoring and Evaluation (M&E) of the programmes. AOSTI, ASRIC and AUDA-NEPAD have put in place a harmonised mechanism that will support Member States and RECs to collect standardised data and report on performance periodically. The analysis of data, annual reports and regular progress reviews constitute an important management tool of the entire system.

While there are conventional mechanisms for funding Research and Development (R&D) and Innovation, it is essential to establish efficient, effective, and coordinated financing mechanisms to implement the strategy. To this end the AUC and AUDA-NEPAD do mobilize and coordinate resources for technical support in developing and implementing national and regional plans and priority programmes. AU Member States and RECs on the other hand, take a lead role in mobilizing public, private and donor resources for the coordinated implementation of national and regional programmes.

1.5 THE POSITION OF THE AFRICAN UNION DEVELOPMENT AGENCY-NEPAD 9AUDA-NEPAD) ON AI-ENABLED SOCIOECONOMIC DEVELOPMENT

AUDA-NEPAD recognise that AI in Africa can address some of the continent's most pervasive challenges to eliminate poverty, improve education, deliver healthcare, and eradicate diseases sustainably. AI can also help African Union Member States address the growing demand for food from the fast-growing population inclusively. Furthermore, AI is expanding access to innovative and productivity-bolstering technology to stimulate the economic growth that the continent needs. Additionally, AUDA-NEPAD observes that AI is profoundly restructuring how work is executed to enhance efficiency and productivity and enhance the delivery of governmental services for citizens.

AI is also expected to generate new and high-value jobs that require technical skills such as network engineers in the banking sector and web programmers in the retail industry. Furthermore, there will be a higher demand for data scientists, robotics experts, and AI engineers. This is because AI will unlock

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the value of data, enhance cognitive processes, and improve predictive capacities. Consequently, this is allowing African governments to manoeuvre and steer better policy frameworks and decision-making. Additionally, AI is expanding socioeconomic growth by potentially doubling Africa's GDP growth rate by 2035. Therefore, the capability to harness even a fraction of this can substantially benefit Africa's economic development and eliminate poverty. Particularly, AI is positively impacting Africa's agriculture, healthcare, public services, and financial services.

The panel opines that speedily developing AI-based technologies can potentially address the highly critical challenges that are negatively impacting Africa's socioeconomic development and growth. For example, agriculture is benefiting from AI-based economies by enhancing planting and harvesting management efficiency and effectiveness to increase yields. Healthcare is being tailored to enhance healthcare quality, accessibility, and decision-making outcomes. AI is also improving the efficiency and responsiveness of public services to enhance the impact. Additionally, access and security of financial services are being expanded as well.

Forward-thinking policymakers are supporting innovative start-up companies and encouraging technology partnerships between civil society groups and international global stakeholders. This is helping these countries to mobilise and promote the growth of a vibrant AI ecosystem in Africa. However, African countries should address the structural challenges that are impeding the development of a healthy AI ecosystem in Africa. This includes adapting education systems to develop the necessary skills required to thrive in the 4IR era, expand broadband coverage, and promote responsible and ethical AI to enhance fairness, security, and inclusive AI applications. Furthermore, ensuring a deeper, broader, and more accessible pool of data can also enable AI researchers, developers, and users to drive AI-enabled technologies.

To transform and change the landscape of 4IR technologies, Africa should address the inherent challenges in the development of AI and embrace these challenges to benefit from AI-based socioeconomic development and growth. This can be accomplished by establishing clear roadmaps to benchmark and influence the adoption and implementation of this technology. African countries should recalibrate their laws and legal frameworks to support data-driven technologies and innovation-driven growth. This can also strengthen the supporting infrastructure for AI development and encourage a collaborative approach to allow concerned stakeholders to share their expertise and insights, and foster trust.

With enabling and suitable policies, Africa can significantly benefit from AI-related transformations. In this way, African countries promote a common digitalisation agenda for the African continent and establish an African Common Position to coordinate and distribute the roles to each stakeholder. This can promote the sharing of experiences and best practices, and exchange lessons learnt on information and communication and digital policies. This can also help African countries consider postal digitalisation as national prioritisation and digital strategy This is enabling African countries to pursue the digitisation of postal financial services and establish cashless systems to facilitate payment and banking systems.

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2 A CASE FOR AI IN AFRICA

AUDA-NEPAD recognizes that to strengthen the AU-AI Continental Strategy for Africa which accompanies the AI White Paper, AU Member States should formulate legislation and laws to facilitate the adoption. This is primarily because some African countries may not yet have developed their own AI strategies or have laws and regulatory frameworks in place to govern AI. Additionally, there may be a need to showcase ongoing AI activities and plans to demonstrate the potential impacts and outputs of the AI economy in Africa.

To enhance the impact of AI technology in Africa, countries will need to strengthen the development of human capital to enhance the impact of AI technology in Africa. Furthermore, the continental strategy should comprehensively capture challenges and opportunities for the youth and include exemplary case studies of AI in human capacity building from AU Member States and informal sector activities. Thus, to strengthen advocacy, AI should be presented more practically to help policymakers to easily understand and grasp the value of investments. This should also include bringing on board diaspora engagements and partnerships. It is important for countries to also consider the vast plethora of African languages when considering AI human capacity building and skills development. This will help make AI relevant for local communities and eliminate language barriers and the various dynamics brought about by the different African languages when communicating.

Considerations on ethical consequences should capture concerns on data protection and safety of AI systems. Further to this, African countries should consider a broader emphasis on the need for training and enabling AI jobs and entrepreneurship within the public and private sectors.

Within the public sector, capacity strengthening can help public sector workers understand the benefits of AI-enabled governance and management. Thus, public awareness and engagement should be considered lifelong learning exercises to enable skills acquisition and support all the facets of socioeconomic activities. Most importantly, women's representation across all existing and emerging technologies should be prioritised, and the current university systems should be used to bridge the different technologies with the communities' engagements.

Furthermore, infrastructure and data foundations and use in AI systems should also be considered to enhance the impact of AI in Africa. For example, data centres require vast and efficient energy to remain operational. Therefore, provisions for efficient and reliable energy sources should be considered. For instance, this can be accomplished by establishing tier 4 green energy data centres to enable reliability, instead of relying on unreliable national electricity grids. Additionally, the data policies should consider the level of development to encourage data ownership and access to data, and the need for developing a reliable electricity grid.

There is a need for skills development in data governance to enable collaborations and sharing of infrastructure. These provisions should demonstrate the need to create benefits and opportunities for data centres and the cost of not taking the necessary actions to ensure AI development in Africa. Such collaborations and partnerships will greatly improve the optimal utilisation of data centres in collaboration with the private sector. AI experts noted that it remains impractical to establish data centres without addressing Africa's unreliable energy challenges, the need for the data market, and optimising the utilisation of data centres to prevent their underutilisation.

This holistic and comprehensive approach will enable all entities to gain access to local data storage facilities and enhance the local market infrastructure. For example, when Meta (Facebook) instals data centres and fibre connections around the African continent accompanied by small computing centres around the shores, African countries should partner with Meta to negotiate access to the data and facilities. This can significantly enhance the opportunities for local data centre infrastructure access and enhance the legal jurisdictions of the data being hosted within African countries. African countries should also strengthen data literacy to enhance human resource capacity, as well as improve the local manufacturing of devices.

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Creating an enabling environment for AI deployment is crucial. To achieve this, it is important to assess the number of countries that currently have AI strategies. This will allow for a clear definition of Africa's AI readiness index according to international standards and facilitate self-regulation to govern AI certification, codes of conduct, and the costs of implementation frameworks. For instance, self-regulation tools for data protection can help companies evaluate themselves on AI ethics.

The AI economy should also be determined to realise its benefits and opportunities for African countries. This can help countries promote the domestication of funding mechanisms to enable self-funding and enhance public-private investments. In addition, the next steps of AI economic adoption and uptake should consider enhancing the security of AI. This can improve trust in Africa's AI systems to enhance the returns to investments within local investments. Therefore, countries should consider the amount of research, development, and innovation required to address African challenges and generate local solutions at national and regional levels.

To promote AI businesses, start-up companies, and entrepreneurship in Africa, the AU-AI Continental Strategy and White Paper focuses on creating an enabling environment by offering incentives such as tax waivers, subsidies, and local funding mechanisms. Consequently, this can create AI business-friendly investment platforms for optimal socioeconomic activities and impacts, especially on local investments and human capital development.

AUDA-NEPAD asserts that building sustainable partnerships can help African governments and innovators to establish and develop comprehensive and viable collaborations and support systems. These partnerships should include domestic joint ventures on common interests, enhance skills transfer partnerships, promote innovation partnerships, and strengthen partnerships on technology, finance, capacity building, and trade.

In creating partnerships based on common ground, the data metrics should cluster the stakeholders based on their interest in AI activities, enable the tracking of their performance, and enhance the sharing of resources. These can be accomplished through short-to-medium-to-long-term partnerships depending on the specific private-public partnerships, and diasporic partnerships. Moreover, these partnerships should be progressive and action-oriented and there should be some mechanisms to measure the progress, benefits, and opportunities of partnerships. Most importantly, the African Union can facilitate and coordinate the partnerships as a neutral body and generate progress reports to help African countries monitor and evaluate their AI uptake progress. Such provisions can help countries be more competitive and seek ways of improving their inputs and outputs.

2.1 EXAMPLES OF AI USE CASES IN AFRICA

The examples and use cases of AI technology in various applications are summarised as follows:

2.1.1 BUILDING AFRICAN MULTILINGUAL TOOLS THROUGH AI

African researchers are collaborating on open-source AI programmes to develop and strengthen machine translation for African languages. This is facilitating communication, enhancing accessibility, and enabling Africans at local levels to exploit AI economic opportunities. Currently, 2,140 languages are being spoken across the continent. Therefore, there is a need to develop neural machine translation systems to position African languages on the technological map. This is also helping to connect Africa's diverse and numerous linguistic populations, especially during the 4IR era.

While Africa has millions of English, French and Portuguese speakers, there exist thousands of other languages being spoken across Africa, and these are being excluded from the digital world's opportunities and information. For example, Congolese from Central Africa do not speak French or English, but instead Congolese national languages such as Lingala, Tshiluba, Kikongo, and Swahili. On the other hand, smartphones are primarily using advanced technologies such as Siri, Google Talk

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and Alexa which have speech recognition that has not been programmed to understand native languages and accents.

Even on the internet, Wikipedia has a depository of open information that substantially underserves local African languages. For example, there are approximately 9.6 million people Swedish speakers in the world, and over 3 million articles are written in Swedish on Wikipedia. However, there are approximately 34 million speakers of the Oromo language in Ethiopia, but Wikipedia contains a mere 786 articles. On the other hand, Google Translate, the most popular automatic translation system available, can only translate 103 of the world's 7000 languages. It is worth noting that there are only 13 African languages on Google Translate. Therefore, there is a need to technologically and digitally avail these native African languages to reduce linguistic exclusion and discrepancies.

AUDA-NEPAD and APET recognize that a significant portion of AI tools is being developed and researched outside of the African continent. As a result, this is putting AI products and services at risk of biases and discrimination and further limiting the depth and capacity at which AI can substantially advance and improve African lives. AI algorithms are defining the future and considerations should be made that algorithms are not just technical, but also political and cultural.

AI technology can enable the African continent to expand and strengthen natural language processing (NLP) in native African languages. Remarkably, the NLP can strengthen systems and computational algorithms to automatically understand, analyse, manipulate, and potentially generate human language. Thus, machine translation, one example of an NLP-based system, can enhance speech recognition, strengthen auto-prediction and correction, and enable sentiment analysis. However, this requires huge amounts of training data to produce decent results. As it stands, African languages are characteristically lowly resourced and have limited, scattered, and non-publicly available essential language data.

In the neural machine translation, the datasets known as parallel text corpora, large sets of texts that are equivalent, sentence-by-sentence, in multiple languages, can significantly benefit in training machine translation models. However, the parallel corpora have limited African languages, while at the same time, there is no shortage of major Western languages. Interestingly, the European Union's (EU) policies and documents are providing high-quality and human-translated parallel corpora in a vast variety of EU languages. Consequently, the availability of parallel corpora documents had real-life implications in terms of the availability of information on the Internet.

To address these limitations and challenges, organisations such as Masakhane, are actively gathering corpora documents. In working together with groups such as Translators Without Borders, these organisations are sourcing publicly available datasets from governmental documents, religious texts, literature, and news. Subsequently, these data will be utilised to develop machine translation models from English to their African mother tongues. Outstandingly, these data sets and translation models being created are open source to enable anyone to utilise them or contribute to the project. Consequently, this will enable African start-up companies, Non-Governmental Organisations, large corporations, researchers, innovators, and international development partners, regardless of the resources they currently possess, to have the capacity to foster and fabricate digital tools for Africa.

For example, Masakhane researchers have developed baseline models of 16 African languages based on the software development platform called GitHub. There are knowledge products and progress reports that have been published at online and international conferences focusing on learning representations. This has also yielded various AI and machine learning engagements to enable knowledge and experience-sharing platforms.

African language translations can assist service providers and governments when crises occur in areas where a low-resource language is spoken to provide relief services. Furthermore, reports have demonstrated that people learn more effectively in their native languages. This will encourage African solutions for African challenges, rather than imported interventions that do not accommodate the local context as they may be misplaced and biased This will encourage African solutions for African challenges, rather than imported interventions that do not accommodate the local context as they may be misplaced and biased. Consequently, automatic AI-enabled translation of African languages through

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digital services and tools can potentially allow Africans to engage further in the digital economy. Therefore, African countries should enable more opportunities to develop localised Africa AI-based technology in their languages.

2.1.2 SUPPORTING PAN-AFRICAN RENAISSANCE WITH AI

There are varied metrics that African countries are utilising to benchmark their key performance indicators in their respective AI strategies. For example, Egypt is projecting that its AI adoption will contribute 7.7% to its GDP by 2030. On the other hand, Botswana has projected that enhancing AI infrastructure will move the country from an upper middle-income country to a high-income country by 2036. Interestingly, South Africa is pursuing a full integration of AI technology into the economy to utilise technological innovation to transform industrial processes and energy provision. As a result, such efforts are envisaged to enhance nutritious food and clean water security and develop smart human settlements.

Senegal is currently constructing an "AI city" approximately 35 km from its capital city. As a result, the inhabitants of this AI city are expected to reside in connected homes, utilise paperless transit tickets and smart parking systems, expand e-health services access, and inhabit next to artificial rivers. Additionally, the Benin Republic is developing its first AI digital neighbourhood in Cotonou. Expectations are that this City of Innovation and Knowledge will be a centre for regional excellence, training, scientific research, and entrepreneurship.

African countries are realising that AI-based technologies are a strategic priority for African countries. Therefore, the legitimization of the technology by the AU Member States should have solid and deliberate efforts to strengthen their capacity to solve Africa's most pressing challenges. However, AI may not solve all of Africa's challenges and in some cases, may even perpetuate and exacerbate some of the existing issues and introduce new risks. Therefore, countries need to carefully and strengthen their capacity in order to utilise AI and consider the technology's risks and threats to infringe on their autonomy, transparency, and privacy of citizens.

Considerations and efforts should also be instituted to ensure a greater benefit of AI-related job creation *vis-à-vis* job displacements. It is importance to work toward ensuring that AI does not perpetuate inequalities and negative systematic biases as these could be utilised to hegemonize Africans. Beyond gaining normative emergence, Africans are ambitiously cascading AI-based technologies to drive and support the socioeconomic development and growth of their societies.

Currently, several reports have demonstrated a "slow" or "low" AI adoption rate of AI-based technologies in Africa when benchmarked across the globe, even among developing regions. However, this trend is changing as several African countries are progressively incorporating AI into the varied aspects of their governance structures and institutions. To demonstrate this trend, through an AI normative emergence in Africa, countries are legitimizing and integrating AI technologies by developing national strategies, establishing agencies, task forces and commissions, amending existing laws and creating new regulatory frameworks, building strategic partnerships, and initiating public sector reforms with AI. Additionally, African countries are driving education, training, and research, and fostering a strategic continental approach to AI.

2.2 BENEFITS OF AI

AI consists of among other attributes a computer programme with the capability to think, learn, and decide on its own. As such, it is a simulation of human intelligence into machines to undertake tasks that will primarily rely on human beings. AI-based capabilities can be classified as weak AI, strong AI, and super AI. Weak AI is focused on undertaking one task at a time and turns not to perform beyond its limitations. On the other hand, strong AI can understand and learn any intellectual task that a human being can. AI researchers are currently strengthening this kind of AI to reach strong AI. Strong AI,

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sometimes referred to as super AI can potentially surpass human intelligence to perform any task better than a human. However, this is still being developed as a concept.

AI consists of three interrelated concepts known as training data, machine learning, and human-in-the-loop. Training data (TD) constitutes the initial dataset from which the algorithm can learn. This constitutes inputs and possible outputs. This is to enable machine learning models to identify and interpret patterns from any given information. When the TD gets better, the algorithm may also perform much better. Machine learning (ML) on the other hand, is the software that trains algorithms to learn automatically from examples, instructions, or direct experience. Consequently, ML can create machines that can learn, develop, and improve their outputs without explicit programming and human assistance. This can in turn enhance the decision-making capacities. The human-in-the-loop (HITL) is a machine-learning model that requires human interaction. In this case, the machines cannot be faultless and are only 70% accurate. Therefore, human assistance is needed to correct mistakes whenever the need arises.

Since AI is a complex process of simulation of human actions and tasks by machines, it can reduce human error and improve accuracy and precision. Worth noting is that every step of decision-making in AI is based on the information that was previously gathered through a set of algorithms. Therefore, when these algorithms are programmed properly, errors can be eliminated. Furthermore, humans can overcome many risks by employing AI-enabled robots to undertake relevant tasks. For example, AI robots can defuse a bomb, go to space, and explore the deepest parts of oceans and forests. This is because machines with metal bodies are resistant in nature and can survive unfavourable atmospheric environments. Moreover, these robots can efficiently undertake tasks and work with more responsibility and sustainably.

AI robots can think much faster than human beings and can perform multiple tasks at a time with accurate results. These AI-based systems can also handle tedious repetitive jobs easily with the help of AI algorithms.

Digital assistance is also useful in some of the most technologically advanced companies to engage with customers and service providers using digital assistants. This is reducing the need for human personnel. For example, many websites are utilising digital assistants to deliver user-requested content. Additionally, some chatbots are so sophisticated that users may mistake them for conversing with human beings.

AI is driving numerous innovations that are potentially resolving some socioeconomic challenges. For instance, recent advances in AI-based technologies have enabled doctors to access tools that can easily detect breast cancer much earlier and efficiently. Additionally, AI can make unbiased decisions because the technology is not driven by. This makes using AI technologies much more practical and a rational approach to ensuring more accurate decision-making. This is also powerful in efficiently automating AI systems in performing repetitive tasks, thereby enabling humans to focus on creativity, problem solving and strategic planning.

For example, banking institutions can expedite the verification of multiple documents using AI Cognitive Automation systems to facilitate loan applications for their customers. AI is currently being applied globally as daily applications such as Google Maps, Alexa, Siri, Cortana on Windows, OK Google, taking selfies, making calls, and responding to emails on mobile devices and the internet are utilising AI tools.

2.3 MYTHS: BROADENED

There exist various myths about AI, which should be addressed to enhance Africa's ability to harness AI-enabled technologies for the socioeconomic development of the continent. There is a misconception that AI is only applicable to large businesses. This is because the development of AI-based solutions is perceived to be particularly complicated and scientific. Furthermore, people usually think about AI as futuristic robots, autonomous drones, and self-driving vehicles. Unfortunately, this tends to imply that

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only advanced technology companies such as Amazon, Apple, and Google, among others, with billion-dollar budgets and elaborate teams of scientists and experts can afford the implementation of AI. Yet, AI implementation does not always demand substantial expert research and investments of millions of dollars. Instead, numerous ready-made intelligent tools are available for a considerable range of companies that can be employed to apply AI to their business processes.

For example, start-up companies can utilise personal assistants such as Siri, chatbots, search and recommendation technologies, Google Maps, autopilots, fraud detection functions, purchase predictions, and more to undertake their various tasks and obligations. As such, AI concepts are not as complicated and mysterious and can be introduced into any business, irrespective of their size. Interestingly, these AI tools can be integrated into the corporate systems of any company. The undertaking may require more expertise in the company's needs rather than deep data science knowledge.

Another myth is that AI algorithms can process any data. It is generally believed that machine learning algorithms are the most important elements in the whole system. This means that an algorithm may appear to be all-powerful and be equivalent to the human brain to understand any complicated data. However, the reality is that the quality and quantity of data matter as algorithms cannot be able to make decisions without any human interventions.

Fundamentally, the machine learning models' working principle requires a definite set of data that will provide high-quality customised data. Even the ultimate algorithm cannot be able to provide the perfect outcome if the data is not well structured. The quality and quantity of training data are as vital to be usable as the intended algorithm to create a functional system. This means that bad data can negatively influence performance, while meticulously processed data can provide good results.

Furthermore, AI cannot be able to make independent decisions as the cognitive programmes are not as self-sufficient as they are believed to be. In this way, AI cannot exist and operate entirely on its own. Thus, this means that computers learn the same way humans learn. The reality is that AI programmes need to be taught first as AI-based programmes and need input data. The input data enable AI systems to learn and make independent decisions in the future. Thus, AI requires various scenarios and use cases defined by people to learn from. Otherwise, these programmes cannot define new scenarios by themselves. Particularly, artificial neural networks can perform exceedingly complicated tasks such as emulating how biological neurons operate. However, there is substantial data that is required to accomplish the complexity of the human brain neural nets. As a result, intelligent technologies require training and human interventions to fully operate.

There are also concerns that AI technologies will replace all human jobs. As such, the worst fear of many employees is that AI will replace them in their workplace, and this will result in widespread job losses. APET recognizes that this myth of AI is justifiable as technological progress has always threatened job losses throughout history. Nevertheless, to counter job losses, AI can be utilised to complement humans to accelerate the creation of more jobs. This threat exists but can be countered by enabling efficient processes to positively influence the current labour market.

There is also a misconception that AI robots will eventually enslave people because the robotic terminators will conquer humankind during an AI revolution to destroy our world. Fundamentally, even with the most sophisticated algorithms, machines cannot be able to think the way human beings do and will hardly learn to do so. Instead, Ai-enabled machines will positively assist humankind in varied socioeconomic fields to establish new business models, enhance skills, and support local communities.

It cannot be overemphasized that there is an existing AI revolution through which society can benefit significantly. APET asserts that there will always be myths and prejudices concerning innovations and emerging technologies, and AI is no exception. Hence APET encourages African countries to strengthen the capacity of relevant stakeholders in order to enhance their understanding of AI.

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2.4 CHALLENGES IN HARNESSING AI

APET posits that there are challenges associated with harnessing AI-based technologies in Africa. There is an inherently high cost that is associated with AI infrastructural installation, skills and capacity strengthening, among others. This is because the ability to create an AI system that can simulate human intelligence will constitute high capital investments. Therefore, this requires sufficient time as well as human and financial resources to effectively install these technologies and undertake extensive research and development, and further requires operating with the latest hardware and software to stay updated.

AI technology does not display creativity and cannot learn to think outside the box. Nonetheless, AI can learn over time through pre-fed data and past experiences. For example, a bot called Quill can write Forbes earning reports. However, these reports only contain data and facts that have already been provided to the bot. Even though it is impressive that a bot can write an article on its own, it still lacks the human touch present in other Forbes articles.

There is also a threat of unemployment associated with AI technologies. For example, AI-based robots are potentially displacing occupations and increasing a few cases of unemployment. As such, there is always a probability of unemployment because of chatbots and robots. For example, AI-based robots are being utilised to replace human resources in manufacturing businesses. This is being observed in some more technologically advanced countries such as Japan.[4] Though, this is also creating additional opportunities for humans to work on other strategic activities and customer engagements, while the robots are enhancing systematic efficiency.

AI applications are also automating most of the tedious and repetitive tasks. As such, since humans are not required to memorise things and solve puzzles to complete tasks, there is a tendency to start using human brains less and less. Therefore, this kind of over-reliance on AI applications can cause challenges for future generations. Furthermore, there are difficulties in incorporating ethics and morality into an AI. Therefore, there are misconceptions that the rapid progress of AI will cause uncontrollable growth of AI to subsequently wipe out humanity leading to AI singularity.

2.5 ADDRESSING THE CHALLENGES IMPEDING THE HARNESSING OF AI IN AFRICA

To address these challenges, African countries should strategically provide solutions such as human capital development in AI, infrastructure and data foundations and use in AI systems, thereby creating enabling environments for AI deployment, AI economy, and building sustainable partnerships. As such, to develop and build Africa's mass of human capital, African countries should create a critical mass of innovations. This will help strengthen unskilled AI labour and enhance the delivery of AI projects. Such efforts can help enable innovators to mitigate AI-related risks and solutions in a private sector-driven economy. African countries should, therefore, promote universal basic data and enable participation for all stakeholders.

African countries should address challenges such as limited investments in science, technology and innovation opportunities and strengthening of AI skills. This will enhance knowledge of, and integration of AI in designing a suitable curriculum and implementation initiatives at lower levels of education such as primary and secondary schools. This should further include considerations of adult literacy with progressive and incremental participation to enhance human capital development in AI. African governments should also provide incentives for students engaged in AI in order to influence the curriculum for a positive work outcome. Such changes would enable students in tertiary education to innovate and strengthen formal jobs sector in Africa. Additionally, the curriculum should be prioritised to benefit the informal sector as it constitutes a large portion of Africa's economic activities.

[4] Japan 2017, AI Technology Strategy, https://ai-japan.s3-ap-northeast-1.amazonaws.com/7116/0377/5269/Artificial_Intelligence_Technology_StrategyMarch2017.pdf

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African countries are also being encouraged to release resources to foster innovation and entrepreneurship. The benchmark case studies such as progress in Tanzania's informal sector due to utilization of AI should be emulated. In addition, there should be pathways for career transition from science, technology, engineering, and mathematics (STEM) career paths into AI-based careers, irrespective of the field of study and training. For example, people can utilise AI with an interest in humanities, law, history, and storytelling, among others. This can encourage continuous AI development through life-long learning, regardless of speciality. Furthermore, general education should strengthen digital skills to encourage programming, critical thinking, and intellectual property (IP) protection, among others.

African countries should also focus on basic science to complement the advancement and application of emerging technologies in Africa. Therefore, African countries should review the educational curriculum to allow stronger skills in basic STEM subjects. Interest in STEM education can also be strengthened by creating competitions such as informatics and mathematics Olympics. Additionally, efforts from African countries should create ecosystems to partner AI innovations with basic science to strengthen foundational subjects across the board. This can serve as incentive-based learning for STEM from primary and secondary schools. Additionally, universities can be designated to strengthen their capacity for STI outputs, and transition from simply focusing on academic work and research into industrial and innovation outputs.

Furthermore, changing the curriculum can also provide a good foundation for the youth before branching into AI. This White paper on AI provides examples of countries that have adopted this approach and demonstrate the outcomes and opportunities of this approach. Due to the diversity of African languages, language-based AI should be pursued to focus on local languages and further simplify communication skills. There are inherent risks that are associated with AI and accompanying AI tools. Therefore, African countries should carefully consider and mitigate these potential risks such as racial bias. This can promote social progress when innovators consider these inherent risks during the development of AI systems. Such provisions can be beneficial against misinformation and keep people interactive on AI systems and innovation.

African countries should enhance the utilisation of data computing and data centres. To this end, more information should be sought to understand the landscape of AI computing infrastructure. Hence AI experts are encouraged to utilise the AU data observatory to ensure that the data is accurate.

The governance and regulation of AI should incorporate ethical principles and African countries should value legislative and legal instruments of governance to enhance fairness, safety, privacy, and security. AI experts should consider the UNESCO guidelines when modelling the ethical principles that are interrelated to fairness, addressing discrimination, and enhancing transparency. Data safety and security can be accomplished through the clustering of ethical AI principles and not necessarily the governance of AI. This will enable the implementation mechanisms and enhance audit institutions, data protection, and data privacy. These ethical standards can also be borrowed from other fields such as medicine and law to improve the regulatory sandboxes.

African countries should also blend the implementation mechanisms to ensure the governance of AI under different pathways such as centralised, decentralised, evolution, or fragmented AI governance systems. Additionally, there is a need for national AI strategies that can clearly define the national AI priorities across all economic sectors and strengthen competitive advantage of each country. AU data policy frameworks can best serve as a basis to establish principles on AU Human Rights and supportive AI ecosystems. This will help African countries adopt AI as a key technology to address socioeconomic activities and drive the demand for local innovation. This can be enhanced by creating incentives such as tax cuts and tax holidays, simplifying business administration, and enhancing direct investment into AI systems and thereby make AI more accessible to small-to-medium enterprises (SMEs) and democratise AI for the public good.

education with the goal of enhanced knowledge of AI should be undertaken to demystify AI. This can be accomplished by establishing AI clubs and communication mechanisms such as case studies around AI on social media and in local languages. As such, Centres of Excellence should be created to enable

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Africans to work on AI policy and create country reports perspectives. This will assist in monitoring and evaluating their AI implementation programmes and create an enabling economic environment by enhancing the frameworks on equity and non-equity. This can be accomplished through governmental and AU support and enhanced AI funding mechanisms. Additionally, AI products should be localised and enable the African government's AI systems for governmental management and public service provisions. Accordingly, African countries should leverage global companies to proactively present projects and provide non-monetary equity to strengthen AI systems in Africa.

2.6 PRIORITY AREAS FOR AFRICA

APET posits that to support local AI capacities that are favourable to local socioeconomic ecosystems, the continent's AI policy responses should be built on national digital agendas. In this way, African countries can prioritise inclusive digital, data, and computing infrastructure and skills development. Currently, Africa is playing a vital role in the global AI supply chain, especially in the early production phase. For example, African countries such as Egypt, Rwanda, and Mauritius have published comprehensive AI strategies.

In 2019, Rwanda launched its National Artificial Intelligence Policy and Strategy, which aims to position the country as a regional hub for AI and promote the use of the technology in various sectors such as healthcare, agriculture, education, and governance. The strategy outlines Rwanda's approach to AI development, which includes the development of necessary infrastructure, skills, and regulations, as well as the promotion of partnerships between the government, private sector, and academia to drive AI innovation.

Additionally, according to the report "Government AI Readiness Index 2022" published by Oxford Insights, Mauritius has published a comprehensive AI strategy, which helped the country to rank first on the African continent and 57th globally in the ranking of countries best prepared for large-scale adoption of AI in the public sector. Furthermore, Egypt has published a comprehensive AI strategy. The strategy is called "Egypt's Artificial Intelligence Strategy: A Roadmap to the Future." It was developed by the Ministry of Communications and Information Technology in Egypt and was launched in 2019. The strategy aims to position Egypt as a regional hub for AI and includes plans to develop the country's AI infrastructure, promote research and innovation in AI, and support the development of an AI ecosystem in Egypt.

Currently, foreign AI technologies are dominating the African continent, providing technology products and solutions that may not align with local developmental priorities. To effectively support local AI capacity that suits local economies and ecosystems, AI policy responses should be based on national digital agendas and prioritise the development of inclusive digital, data, and computing infrastructure, as well as skills.

Egypt has declared in the country's national AI strategy that unfavourable foreign agreements should not be implemented to support Egypt's AI activities. This is aimed at removing incompatible AI applications and enhancing inclusive developmental priorities. As such, the implications of AI's gender equality should be carefully considered to address Africa's existing digital gender divide and the regression of gender equality. These efforts should prioritise exploiting the advances in information-based economies and analytics-based economies that have occurred, especially during the pandemic era. Thus, AU Member States should explore a coordinated response to AI governance and implementation based on shared commitments to advance responsible AI and socioeconomic development and growth.

Price Waterhouse Coopers (PwC) published a 2017 seminal report that projected an AI global economy of approximately US$15.7 trillion by 2030. However, the AI wealth and power distribution afforded by AI technologies has been, to date, widely unequal. As such, Africa's AI advancement and growth remain negligible. Yet, given that AI production is being implemented at a planetary level, Africa is already substantially participating and contributing towards developing AI systems. Furthermore, AI

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technology requires the use and availability of Africa's natural resources, labour, and skills. Despite the worldwide reach of the AI supply chain, the benefits of these technologies have not been realised in Africa. Instead, the largely accrued huge technological companies of North America, Europe, and China have demonstrated AI advances through smart speakers such as Amazon's Alexa, and smart cars.

In contrast, the African continent is boasting a unique context that is well-positioned to exploit AI technologies to advance local socioeconomic development and growth. African countries can potentially advance technological infrastructure that is associated with the 3rd Industrial Revolution such as electricity and computer advancement. Additionally, there is a thriving and dynamic young population in Africa that is willing to embrace new forms of digital work and entrepreneurship. Consequently, African governments should prioritise the adoption of AI solutions that bolster the achievement of their national developmental objectives and facilitate the creation of prosperous and equitable societies.

AI policy responses are emerging across Africa such as Egypt, Mauritius[5], and Rwanda have published their national AI strategies.[6] Nevertheless, Africa remains dominated by foreign technology and these AI companies are not necessarily supporting the realisation of the national developmental priorities such as those outlined in the AU's Agenda 2063 and United Nations Sustainable Development Goals. In some cases, these companies are excluding certain groups, particularly women. Therefore, African policymakers should prioritise the growth of local AI infrastructural and skills capacities that can significantly advance inclusive socioeconomic growth and transformation. This prioritisation necessitates AI policy responses that can build on comprehensive national digital agendas. African countries should also focus on equitable access to digital, data and computing infrastructure.

2.7 GENDER DIMENSIONS OF AI

Africa's digitalisation policies are supporting the equitable participation of women in the digital economy. These policy directions and considerations are also attempting to identify, discuss, and analyse a range of drivers that are perpetuating the digital gender divide. In bolstering the evidence-based critical policy areas, this analysis will complement the essential initiatives, policies, actions, and national practices. These can have a significant and measurable impact in linking the digital gender divide and supporting the mainstreaming of gender across Africa's AI drive.

African countries are instituting several valuable actions to narrow the gender gap. This includes enhancing the accessibility, affordability, skills development, and inherent biases and socio-cultural norms that restrict women and girls' ability to benefit from the opportunities availed by digital transformation. Furthermore, girls' relatively inadequate educational enrolment in science, technology, engineering, and mathematics (STEM) and information and communication technologies (ICTs) is also impeding their performance in the digital world. There is also limited usage of digital tools and relatively insufficient digital platforms for entrepreneurship. This is potentially widening the digital gap and inequality, especially in rural areas.

Reports have also demonstrated that women are receiving comparatively less financing for their innovative endeavours. Additionally, women are repeatedly confronted with limiting restraints in their professional ambitions, especially within the technology industries. This turns out to be a vicious circle that could further widen the digital gender divides. Yet, enabling, and appropriate policy frameworks, accompanied by well-coordinated and complementary interventions and actions, may reverse these trends and trigger more inclusive paths. These interventions can particularly narrow the digital and gender gaps by enhancing awareness and tackling gender stereotypes. This can enable enhanced, safe, affordable, and accessible digital tools to foster sustainable partnerships across stakeholders to enhance girls' and women's full participation in the digital economy.

[5] https://afripoli.org/ai-in-africa-key-concerns-and-policy-considerations-for-the-future-of-the-continent.
[6] https://oecd.ai/en/dashboards/policy-initiatives/http:%2F%2Faipo.oecd.org%2F2021-data-policyInitiatives-27391.

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APET realises that AI technologies are providing new opportunities for making progress, underscoring the importance of broadening access. Nevertheless, gender-based digital exclusion should be addressed by removing the hurdles that are impeding access, affordability, limited education and skills and technological literacy, and inherent gender biases and socio-cultural norms. These can be enhanced by implementing affordable access to digital tools and policy interventions to address long-term structural biases. This includes addressing connectivity as there are approximately 327 million fewer women than men that have a smartphone and can access mobile internet, worldwide. Fundamentally, women are 26% less likely to have a smartphone than men. In South Asia and Africa, these ratios stand at 70% and 34%, respectively.

Furthermore, the gender divide in internet usage and accessibility is also widening. Even though the global digital gender divide in internet usage was almost constant at about 11% between 2013 and 2017, the gap between developed and developing countries increased. This was driven by an increased gender internet usage gap of about 3% points in the least developed countries and 4% points in Africa. However, AI-enabled technologies promise to expand opportunities that could help empower women. As such, the internet, digital platforms, mobile phones, and digital financial services, can provide opportunities for African women to bridge the divide by enabling women to have access to earn additional income, upsurge employment opportunities, and provide access to knowledge and general information. This can substantively benefit women and their families, and thereby, enhance the lives and well-being of the entire society.

APET recognises that women can benefit greatly from bolstering their use of digital tools. This can be accomplished by enhancing the scope for women to extract more value from their use of AI tools. Currently, female users tend to utilise fewer services than men and are likely to be less confident in using the internet. For example, mobile money accounts are providing more mechanisms to bolster financial inclusion, however, fewer women are likely to exploit such platforms. To upskill women, African countries and the private sector should enhance the awareness gap through capacity strengthening such as online or video-based upskilling and tutorials. This can especially help women use digital tools and extract more value from them.

Compulsory education can help eliminate the digital gender divide. Compulsory schooling can ensure that individuals gain the basic skills and competencies needed for full participation in labour markets and society. At the age of 15, the gender gap in terms of skills in the digital area is not distinct. Fundamentally, girls are underperforming boys in specific digital-related skills, however, girls are outperforming boys in collaborative problem-solving skills. Collaborative problem-solving skills are increasingly being valued by employers and businesses as necessary 21st-century skills. Furthermore, even though women are displaying greater literacy and collaborative problem-solving skills than men at the age of 15, this gap in literacy is bridged by the age of 27 for the average man. Particularly, men's advantage in numeracy skills increases with age.

Most importantly, gender-specific expectations about the future should also be changed. For example, at the age of 15 years old, 0.5% of girls aspire to become ICT professionals, in contrast to 5% of boys across OECD countries. Furthermore, twice as many boys as girls aspire to be engineers, scientists, and architects. Therefore, changing the gender-specific expectations about professions is vital towards influencing girls into STEM career paths. This is because fewer women are currently graduating in engineering, manufacturing, and construction, or ICTs. Even though there were more women than men that completed tertiary education in 2015, only 24% of the women graduates were in engineering, manufacturing, and construction. There were only 25% of the women in ICT. Besides the lower graduating number, when these limited women graduate engage in the labour market, they turn to display lower numeracy skills than male graduates. Therefore, enhancing awareness about STEM education opportunities for women can reverse these trends and increase their participation in STEM subjects.

African countries are encouraged to remove obstacles to adult education for their workers, particularly for women. This can be accomplished by instituting more flexible opportunities for adults to upskill and reskill through well-coordinated institutional and training programmes. There should also be

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augmented participation in the labour markets through digital platforms and job quality. This can ensure that women are benefiting equally to men by availing digital technology flexibility, increased remuneration, job security and social protection.

A well-structured redistribution of unpaid childcare and housework could help strengthen women's participation in the digital labour markets. Markedly, women turn to spend 2.6 times more time on unpaid care and domestic work than men. Consequently, this is restricting their opportunities for paid work and upskilling themselves. Therefore, efforts should be instituted to increase gender-biased awareness, challenge gender stereotypes and norms, and foster gender-neutral parental leave-taking and childcare services. This can address norms, attitudes, and behaviours about childcare and housework and augment female participation in the digital labour markets and training, especially AI technology. This includes narrowing the gender wage gap by instituting and implementing policy frameworks that can equip female workers with more self-organisation, management, and communication, as well as advanced numerical skills. This can encourage substantial female enrolment in STEM-related studies and apprenticeships, and innovation by targeting existing gender biases in curricula and parental preferences.

Garnering women's participation in inventive activities should also be increased by encouraging their participation in innovation teams. Therefore, female participation in patenting activities should be enhanced much more substantially. Greater inclusion of women in inventive and innovative activities can result in stronger economic growth and enhanced societal well-being. This is because inventions that are arising in diverse and gender-balanced teams, even from women-only groups, appear to exhibit a broader technological breadth. This turns out to have more economic value and a superior impact than when only men are involved. This includes software development that demonstrates more male dominance.

The gap in entrepreneurship, especially in start-ups and venture capital investment, has demonstrated socio-cultural gender bias. The gender gap in entrepreneurship is strikingly persistent as men are nearly twice as likely as women to be self-employed. Men are also three times more likely than women to own a business with employees. Furthermore, 90% of innovative start-ups seeking venture capital investments are more likely to be founded by men. Unfortunately, women-owned start-up companies are receiving approximately 23% less funding than men. About 30% of these women-led start-up companies are less likely to have a positive exit such as being acquired or issuing an initial public offering when compared to men-owned businesses. Nevertheless, venture capital investors with at least one female partner are more than twice as likely to invest in a company with a woman in the management team. In addition, these venture capitals are three times more likely to invest in female chief executive officers.

African countries are encouraged to pursue well-structured gender equality initiatives to scale up women's active participation, implementing lessons learnt in improving the equitable sharing of the benefits of digitalisation and addressing the structural root causes of the divide. For example, success at enhancing women's participation in STEM-related career paths will limitedly bridge the gender gaps if these women are relentlessly and habitually confronting unchanged biases in the workplace. Therefore, evidence-based policy development and implementation should systematically gather relevant data, identify priorities, and define the critical lines of action. Promoting the addition of gender-related dimensions in official statistics is important in this respect to ensure stronger and positive policy action in an inclusive digital future.

African countries are also encouraged to formulate and implementation of national digital strategies that are actively addressing gender digital inaccessibility and improving the affordability and safe digital economy. This can be accomplished by extending networks and digital access through satellite and fibre in urban and rural areas and promoting access and affordability of digital devices such as smartphones, tablets, and laptops, especially for low-income individuals. African countries should also bolster the availability and promotion of e-banking and mobile money, particularly to women and other disadvantaged categories.

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African countries should also establish timely specific targets for women in STEM by establishing fund and grant schemes that can potentially expand women in STEM enrolments and participation. Furthermore, African countries can establish awards and prizes to enhance the visibility of women in STEM and high-technology sectors. Implementing awareness campaigns that can adequately tackle sociocultural norms and biases and stereotypes should also be prioritised. This can help facilitate the labour market participation of women and help monitor the job quality and support services to women pursuing STEM careers while being mothers or having a family.

2.8 COST-BENEFIT ANALYSIS

Reports are showing that by 2030, AI will augment the global GDP by approximately US$15.7 trillion. On the other hand, approximately US$6.6 trillion is projected to come from enhanced productivity and US$9.1 trillion is derived from consumption effects. Furthermore, the augmentation that enhances the working modalities of people and AI machines will create approximately US$2.9 trillion of business value and 6.2 billion hours of worker productivity globally. Since the world progressively observed enhanced connectivity, data has become universal and valuable. Therefore, Africa can effectively leverage AI technology to propel extensive and comprehensive transformation and effectiveness.

African countries should foster 4IR-based economic development to exploit technologies such as cybersecurity, cloud computing, big data analytics, blockchain, the Internet of Things, 3D printing, biotechnology, robotics, energy storage, and AI. In particular, AI is presenting a myriad of socioeconomic development and growth and optimal solutions to Africa's challenges, especially for struggling industries. For example, AI-enabled healthcare solutions can enable the limited workforce to expand their impact and effectiveness with the limited facilities available. This can be accomplished by speeding up the initial processing, prioritization, diagnosis, and post-care follow-up consultations. Furthermore, AI-based pharmacogenomics applications can help maximise the likely responses to personalised therapeutic drugs based on certain genetic markers and help tailor treatments. Therefore, considering Africa's genetic diversity, these AI-based technologies can advance medical treatment to match global standards.[7]

Advanced algorithms and machine learning methods can leverage genomic precision in livestock production models. As such, genomic precision can help farmers build intelligent breeding programmes to minimise the ecological footprint, address the forever-altering consumer demands, and enhance livestock production processes. Therefore, AI can transform and enhance connectivity to drive competitiveness in agricultural activities in Africa. However, Africa should rapidly activate, adopt, and implement various AI-powered solutions by facilitating and enabling regulatory systems to expand the digital ecosystem. Furthermore, African countries should enhance technical skills capacity, bolster adequate investments into research, development, and innovation, develop innovative financial instruments, and heighten public-private partnerships. African countries can also finance human capital development to focus on industrial research and innovation hubs. This can bridge the gap between higher education institutions and the private sector to guarantee the evolution of AI products from the laboratory to the marketplace.

2.9 OPPORTUNITIES FOR LEAPFROGGING AI-ENABLED SOCIOECONOMIC DEVELOPMENT AND GROWTH

The opportunities for strengthening Africa's AI technology include developing national AI strategies. African countries such as Mauritius, Egypt, Zambia, Tunisia, and Botswana have recognised the potential for AI to expand the GDP and provide a competitive advantage. To this end, these AU Member States are driving their socioeconomic expansion by developing national AI strategies. These strategies

[7] Lee, D., & Yoon, S. N. (2021). Application of Artificial Intelligence-Based Technologies in the Healthcare Industry: Opportunities and Challenges. International journal of environmental research and public health, 18(1), 271. https://doi.org/10.3390/ijerph18010271.

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are advancing investment capacity, strengthening talent development, and providing financial aid. For example, Mauritius was one of the first African countries to publish its 70-page AI national strategy called the Mauritius AI Strategy (MAIS). The MAIS denoted Mauritius' dedication to strengthening an AI-based socioeconomic development model.

On the other hand, Egypt has created an AI strategy that is focused on a specialised AI academy and utilising AI for governance and business enterprises driven by data science. Zambia's "Smart Zambia" is an e-Government Master Plan that is coordinating an e-Government framework. This is leveraging AI usage within the Member State's institutions. Tunisia's National Agency for Scientific Research Promotion (ANPR) inaugurated its action strategy and enterprises for the Tunisian AI strategy. Botswana's strategy is to utilise AI through its Science, Technology, and Innovation Action Plan to advance economic growth and job creation.

African countries are also encouraged to establish AI Agencies, Task Forces and Commissions. African countries such as Kenya, South Africa, Uganda, Mauritius, Tunisia, Egypt, and Nigeria have established such agencies and commissions. For example, Kenya instituted the Blockchain and AI Task Force to contextualise the application of AI in Kenya's financial inclusion, cyber-security, land titling, elections, and single digital identity processes. South Africa also established a Presidential Commission to develop an integrated national response strategy to enable the adoption of AI. Subsequently, the Presidential Commission presented a diagnostic report to the South African President. On the other hand, Uganda's national AI task force is focused on tackling local economic challenges such as AI applications in expanding agricultural production and efficiency. Agriculture was prioritised in Uganda because the population relies substantially on agricultural business activities. To this end, Uganda set up its task force to advise the government on domesticating AI to strengthen Uganda's socioeconomic development and growth.

Mauritius has instituted an AI Council that oversees all AI project implementation in the country. This council is also quantifying the socioeconomic impact of AI in Mauritius. Furthermore, Tunisia's ANPR has now established an AI task force, whilst Egypt has created a National Council for AI. These are overseeing the implementation of AI to match the international developments in the field. Nigeria has established a National Agency for Research in Robotics and AI. This is leveraging collaborations with international research bodies on robotics and AI and enabling AI education in Nigeria.

African countries are also encouraged to promulgate AI laws and regulations. African countries such as Ghana, Sierra Leone, South Africa, Uganda, Zambia, Zimbabwe, Senegal, Tunisia, Kenya, South Africa, and Nigeria formulating AI laws and regulations. This is vital because some African States are demonstrating completely unreasonable assertions of regulatory oversight on AI within their respective territories. On the other hand, some African countries are adopting the "wait and see" approach and other countries are beginning to take active steps toward domestic regulatory oversight.

Even at the supranational level, the African Union is also formulating the AU-AI Continental Strategy for Africa that will serve as a blueprint for structured regulation of AI. This will help Africa manage the benefits of the technology for Africans and can predict to curb the risks to promote responsible AI in Africa. Additionally, at the United Nations (UN), African countries such as Ghana, supported by Sierra Leone, South Africa, Uganda, Zambia, and Zimbabwe have expressed a desire to negotiate a new international instrument. This treaty will address concerns over lethal autonomous weapons using AI and other similar emerging technologies.

At the national level, Senegal has launched several initiatives to establish an enabling regulatory and policy framework for start-up companies, particularly in the AI space. The Policy Hackathon known as the 'Start-up Bill' has been submitted to the government for passage to become law. As such, the 'Start-up Act' is legitimizing Senegal's Digital Strategy. Senegal is the second African country after Tunisia to pass AI start-up legislation. While some of the recent laws and regulations are not exclusively applicable to AI, these laws and regulations can be applied to the use of AI within the existing infrastructures. For instance, Kenya's new data protection laws are complying with the European Union's legal standards. These are placing restrictions on how personal data can be handled, stored, and shared. Even South Africa's Protection of Personal Information Act and Nigeria's Data Protection

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Regulation of 2019 are complying with the European Union legal standards. In these cases, the applicability of AI can be inferred when it involves personal data in AI-based transactions. Zambia and Mauritius are set to be proposing AI-targeted bills for passage into law.

African countries are also advised to initiate a public sector reform with AI-enabled systems. African countries such as Rwanda, Kenya, Tunisia, South Africa, Uganda, Rwanda, Tanzania, and Cameroon are implementing efforts to reform the public sector. For example, Rwanda enlisted anti-epidemic robots to strengthen its fight against the coronavirus pandemic. The Kenyan government departments and their respective Ministries of Lands and Health have employed blockchain technology to enhance service delivery and data management. Tunisia is employing AI applications in the Public Finance Management Information System to enhance fraud detection, budget efficiencies, and financial analytics. The country is also using AI tools to enhance policing, security, and wildlife conservation procedures.

Uganda is employing AI tools for facial recognition and South Africa is using AI tools to detect gunshots. South Africa was the first country after the United States of America to implement "shot spotter" audio technology.[8] This technology is being utilised to fight wildlife poaching in the Kruger National Park and prevent gun violence on the Cape Flats in Cape Town. Rwanda and Tanzania have completely automated their drone delivery programmes to ensure efficient public welfare. These drones are delivering medical supplies such as blood and vaccines to remote areas. Cameroon is supporting and funding the first "Made in Cameroon" drones by Will & Brothers. These AI-powered drones are providing public services such as security surveillance, media coverage, and agriculture.

Egypt, South Africa, Rwanda, Cameroon, Morocco, Senegal, Lesotho, Namibia, and Ethiopia are driving AI-specific education, training, and research programmes. Between 2017 and 2020, several African governments have approved and, in some cases, initiated AI centres and programmes to stimulate knowledge capacity, AI acquisition, and the mobilisation of AI. For example, the Kafr El Sheikh University in Egypt has established the first-ever Faculty of AI. In South Africa, the Centre for AI Research (CAIR) has established research nodes with the University of Cape Town, the University of KwaZulu-Natal, North-West University, the University of Pretoria, and Stellenbosch University. Furthermore, Google is supporting graduate programmes in Machine Intelligence at the African Institute for Mathematical Sciences Centre in Rwanda.

Cameroon established the first AI Centre at the University of Yaoundé. This centre is hosted at the National Advanced School of Engineering, Polytech, of the University of Yaoundé, and the Centre is providing high-quality services for students, trainers, companies, and other partner organisations. On the other hand, Morocco's Euromed University of Fez (UEMF) has established the Euromed School of Digital Engineering and AI (EIDIA). The EIDIA is a brand-new centre devoted to AI research, development, and education. Morocco's AI training programmes are supported by the French Ecole Polytechnique (L'X).

Senegal's Dakar Institute of Technology has partnered with the French AI school called VIVADATA, to offer a 10-week boot camp and a master's degree programme in AI for different specialisations. On the other hand, Lesotho's Department of Mathematics and Computer Science at the National University of Lesotho has been mandated to include research on AI systems and projects. Ethiopia established the AI & Robotics Centre of Excellence to foster well-structured collaborations and partnerships between academics and entrepreneurs in AI and robotics.

Ghana, Tunisia, Rwanda, Uganda, Zimbabwe, Ethiopia, Mali, Egypt, Malawi, Namibia, Côte d'Ivoire, Kenya, Nigeria, and Senegal are building strategic partnerships to facilitate AI adoption. Therefore, with the several partnerships that these AU Member States have initiated with international organisations, businesses, and other governments alike, these African countries are legitimising the use of AI within several sectors domestically. For example, Google has built the country's first Africa AI

[8] US 2020, AI Strategy for the U.S. Department of Justice, https://www.justice.gov/jmd/page/file/1364706/download

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laboratory in Ghana to provide developers with the necessary research to build products that can disentangle and resolve Africa's distinctive challenges.

Tunisia and USAID are developing and delivering their taxation policy to strengthen the fiscal reforms using AI and general algebraic modelling system software. In contrast, Rwanda has established a 10-year contract with a digital healthcare provider called Babyl. This is to create Africa's first universal primary healthcare service through an AI-powered triage and symptom-checker platform. The drone delivery service with Zipline is enabling the delivery of medicine and blood to remote areas. Rwanda has also partnered with the World Economic Forum to expand the country's diagnostic capacities for detecting cancer.

Uganda has partnered with the UN to utilise machine learning-powered systems to analyse radio content and utilise drones to assess the needs of displaced populations. This is helping populations that are fleeing conflicts and persecution in Mali, Nigeria, and South Sudan. Furthermore, Uganda has also launched a partnership with Huawei's AI-powered facial recognition surveillance system. On the other hand, Zimbabwe has partnered with a Guangzhou-based start-up company called CloudWalk Technology. This is supported by China's Belt and Road initiative to begin a large-scale facial recognition programme throughout the entire country. Ethiopia has partnered with the Chinese e-commerce giant, Alibaba Group, to establish an Electronic World Trade Platform. Additionally, Mali has partnered with the Netherlands-based Water called Peace and Security Partnership (WPS) to forecast conflicts arising from water insecurity. The Estonian soldiers serving in Mali are utilising unmanned ground vehicles for patrol.

Egypt has partnered with Microsoft, ESRI, VMware and Teradata to deploy AI applications that can potentially provide safe, sustainable, and smart services in Egypt. Malawi has partnered with UNICEF to utilise drones for humanitarian work and safeguard elephants. Namibia has partnered with UNESCO and the Southern African Development Community to host AI consultations so Namibia could strategise and support its 4th Industrial Revolution efforts. The African Development Bank has partnered with Microsoft to establish the Coding for Employment Programme in Côte d'Ivoire, Kenya, Nigeria, Rwanda, and Senegal.

In 2019, African Ministers responsible for communication, and information and communication technologies approved and implemented a continental-wide declaration focusing on a collective and coordinated approach to AI. This will help foster a pan-African approach to AI as the AU Member States have adopted an African Common Position towards adopting AI. This will be a position that is legitimizing the Malabo Convention on cyber-security and recognising personal data protection. This is also supported African Union by fostering a common African stance on adopting AI. As such, the AU's Agenda 2063 is significantly enabling and promoting the ability of all African countries to achieve socioeconomic goals and sustainable economic growth anchored on Pan-Africanism and African Renaissance ideals.

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3 OVERVIEW OF INTERNATIONAL AND NATIONAL AI STRATEGIES

The SmartAfrica Alliance was established in 2013 and launched the SmartAfrica Blueprint in 2014, which is a roadmap for implementing ICT across Africa. These African Heads of State and Governments developed the SmartAfrica Alliance to advance information and communication technologies and digital development across the African continent. After its establishment, SmartAfrica Blueprint has since published a series of policy blueprints for African countries to adopt various digital governance mechanisms including smart cities and agricultural technology. In 2021, SmartAfrica in collaboration with the South African government published the Blueprint on AI for Africa. This Blueprint was expressing AI technology as an epicentre technology that is impacting all levels of socioeconomic development and growth.

The Blueprint has suggested an AI strategy for African countries that will encompass human capital, venture capital investment, infrastructure, networking, and regulation. The human capital should be developed to constitute a technologically skilled workforce and AI talent. African countries should also ensure that laboratory ideas and prototypes are taken into the marketplace. This can be accomplished by designing AI solutions that can be scaled up to entice venture capital investments. The AI infrastructure is necessary to develop AI locally such as access to data and high-powered computing. The networking should be expanded to create an ecosystem of public and private bodies and partnerships, as well as international organisations and industrial bodies. Regulation should also be addressed to encompass emerging challenges and opportunities of AI at national and sectoral levels. For example, Mauritius's AI Strategy is including critical usage cases for AI across agriculture, healthcare, education, financial services, energy, transportation, and climate change.

This is demonstrating that the emerging AI policy frameworks should be adopted in Africa to address concerns around data protection raised by digital ID systems. For example, strong personal data protection laws should have effective oversight bodies to counter potential harm. There should also be substantial efforts towards building national AI ecosystems that are supported by the necessary data and computing infrastructure. This can effectively counter foreign technology influences across Africa to promote locally focused AI solutions.

Furthermore, to strengthen the labour markets, African countries should emphasise emerging frameworks. Particularly, Egypt's National AI Strategy is ascertaining that human labour is not completely displaced by AI-driven automation wholesale. There should be adequate attention dedicated to the labour rights of the digital workforce such as click-labourers and the gig economies. These emerging frameworks should also address and appreciate the potential that AI holds for promoting democracy. This includes identifying and controlling the spread of fake news, inappropriate takedown rules, and the violation of human rights. For example, AI-based facial recognition technologies should not negatively impact the environment and cultural rights.

Furthermore, African countries should develop AI-related policy areas in Africa such as data governance to support the local development of AI solutions that address local developmental challenges and priorities. For example, the Kenyan Data Protection Act, 2019 necessitates that a copy of all personal data transferred outside the country should also be kept and stored within the country. While the Kenya Data Protection Act is primarily focused on personal data, a new Draft Data and Cloud Policy from South Africa requires a copy of all data generated in South Africa to be stored within the country. This provision of the Draft Policy has faced widespread criticism along with other emerging policy choices in Nigeria. This is promoting data localisation, creating the conditions to legalise mass government surveillance, and demonstrating a data governance regime. This should be undertaken under the best practices related to stewardship, rather than focusing on ownership of data.

Re-skilling policy responses should be implemented to prevent threats of job losses. Therefore, providing reskilling and upskilling programmes to existing workforces. Special attention should be provided to African women who turn to occupy most of the low-skilled labour positions and repetitive tasks. In addition, given the reach of platforms such as Facebook and Twitter, Africa should institute essential independent human rights and data protection oversight bodies. These bodies can exercise

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their mandates such as holding social media companies into account when platform-based activities are infringing on human rights and negatively impacting the political stabilities of African countries.

African countries should also have policy transfer opportunities and responses to protect fundamental human rights and freedoms and uphold democracies. The Africa-European Union Global Gateway is providing €150 billion of investments in Africa to support green and digital transitions and cooperation between the two regions. As such, investments in the digital transition are prioritised to include submarine and terrestrial fibre-optic cables beyond the cloud and data infrastructures.

3.1 BRIEF OVERVIEW OF AFRICAN COUNTRIES' STAGES OF AI DEVELOPMENT AND POLICY MANAGEMENT

For Africa to address AI-related issues such as digital IDs and biometrics, facial recognition systems, social media content takedown, click work, gig economies and foreign influences, the African continent should understand the AI life cycles and supply chains. This encompasses enhancing inclusive local development, particularly national policy frameworks. These national policy frameworks should prioritise emerging AI policy frameworks that can advance the beneficial local, national, and regional AI systems and policy responses to AI.

Based on Onuoha's African AI policy survey for the 2019 Global Information Society, it was discovered that only 17 out of 55 African Union Member States have implemented Comprehensive Data Protection and Privacy Legislation. These African countries include Angola, Benin, Burkina Faso, Cape Verde, Côte D'Ivoire, Gabon, Ghana, Lesotho, Madagascar, Mali, Mauritius, Morocco, Senegal, Seychelles, South Africa, Tunisia, and Western Sahara. However, in the 2020 Global Government AI Readiness Index, Mauritius (45th in the world), South Africa (59th), Seychelles (68th), Kenya (71st), and Rwanda (87th) were identified as the top five African countries.

Reports have also demonstrated that Tunisia and Egypt's governments are progressively advancing towards AI readiness. Remarkably, the African country that is credited with having the first fully formalised national AI strategy is Mauritius. This country has launched its Mauritius AI Strategy. This was launched along with the Digital Government Transformation Strategy 2018–2022 and the Digital Mauritius 2030 Strategic Plan, in December 2018. Furthermore, Mauritius has established a Mauritius AI Council (MAIC). Nigeria also launched a publicly run Centre for AI and Robotics (CFAIR) in November 2020

Several other AU Member States have established and mandated task forces to develop their national AI strategy. For example, Kenya established its Distributed Ledgers Technology and AI Task Force in February 2018. In July 2019, the task force reported on the potential and realised impacts of AI on vital socioeconomic developmental areas such as healthcare, food security, manufacturing, housing, and education. The report further provided some arguments that can target enabling AI regulation, but there were limited policy suggestions and recommendations.

Tunisia launched an AI task force in April 2018 through Tunisia's Agence Nationale de la Promotion de la Recherche Scientifique (ANPR) and supported by UNESCO's Chair on Science, Technology, and Innovation Policy. On the other hand, South Africa established the Presidential Commission on the 4th Industrial Revolution in April 2019. Further to this, Uganda launched the country's Expert National Task Force on 4th Industrial Revolution Technologies in April 2019. Egypt's National AI Council was launched and tasked with the development of the country's AI strategy in February 2020. Rwanda also announced the development of a National Emerging Technology Strategy and Action Plan in June 2020.

These entities were mandated with building their national AI expertise and policy capacity. There are also university-driven national AI capacity-building programmes that are being implemented in several African countries. These include Egypt, South Africa, Cameroon, Morocco, Senegal, Lesotho, and Ethiopia. For instance, South Africa's Centre for AI Research (CAIR) was established in 2011 to link nine research groups from six universities. These are the University of Cape Town, the University of

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KwaZulu-Natal, North-West University, the University of Pretoria, Stellenbosch University, and the University of the Western Cape. This centre is funded by the Department of Science and Innovation (DSI) and coordinated by the Council for Scientific and Industrial Research (CSIR).

The University of Pretoria is actively participating in a national AI policy engagement exercise. To this end, the university's Data Science for Social Impact research group has participated in the Policy Action Network (PAN) that was convened by South Africa's Human Sciences Research Council. Consequently, the University of Pretoria published an AI and Data Series of brief guides to facilitate AI's interfaces with equity, crime prevention, education, cities and towns, migration management, and health in 2020. Additionally, South Africa established a Centre for the 4th Industrial Revolution at the CSIR in 2017 as part of the global network supported by the World Economic Forum (WEF).

At the African continental and regional levels, there are vital African AI-based continental instruments that were established as per the mandate from the 2014 AU Convention on Cyber Security and Personal Data Protection. Notably, by the middle of 2020, only eight AU Member States had signed, ratified, and deposited the convention. In October 2019 in Sharm-El-Sheik, Egypt, AU ministers responsible for communications, ICTs, and postal services, convened the AU Specialised Technical Committee on Communication and Information Communication Technologies (STC-CICT). The STC-CICT advised AU Member States to establish a technical working group focusing on AI technology based on existing initiatives and in collaboration with African Institutions. Furthermore, African countries were challenged to create a common African stance on AI, the development of an African-wide capacity-building framework, and the establishment of an AI think tank to assess and recommend projects to collaborate on in alignment with the AU's Agenda 2063 and UN SDGs.

The AU's Cybersecurity Expert Group (AUCSEG) was inaugurated in Ethiopia in December 2019. This group advised Africa to articulate the continent's philosophy, ethics, policy, strategies, and accountability frameworks for cyberspace, cybersecurity, and cognitive AI. Furthermore, at the regional level, the Economic Community of West African States (ECOWAS) adopted a binding 2010 Supplementary Act on Personal Data Protection within ECOWAS. Other African regional economic bodies have generated non-binding instruments to deal with AI-related needs. For example, the East African Community (EAC) drafted the EAC Legal Framework for Cyber Laws, and the Southern African Development Community (SADC) drafted the Model Law on Data Protection in 2012.

To foster an African AI policymaking capacity, the AI for Development in Africa (AI4D Africa) was established. This programme is funded by the International Development Research Centre (IDRC) and the Swedish International Development Cooperation Agency (SIDA). In September 2020, AI4D Africa called for proposals for two AI policy research "think-and-do tanks"—one in Anglophone Africa, the other in Francophone Africa. These were to generate AI policy research that could inform and facilitate the development of public policy and regulatory frameworks, promote the inclusive benefits of AI, and mitigate the potential costs and risks of AI implementation in Africa.

3.2 UNITED STATES OF AMERICA

The United States of America has been at the forefront of AI research and development for several years, and the country's leaders have recognized the need for a comprehensive AI strategy. In 2019, the White House released the "Executive Order on Maintaining American Leadership in Artificial Intelligence," which outlined a policy framework for advancing AI in the United States. The strategy includes investing in AI research and development, promoting AI education and training, and supporting the development of ethical and responsible AI. The federal government has also created the National Artificial Intelligence Initiative Office to coordinate and oversee AI research and development across various agencies.

In terms of infrastructure, the United States has made significant investments in supercomputers and data centres to support AI research and development. The country's academic institutions and private sector companies have also made significant contributions to AI research, with some of the world's

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leading AI companies based in the United States. Implementation strategies have focused on deploying AI to improve government services, enhance public safety, and spur economic growth. The United States has also been actively engaged in international discussions on AI governance and ethical considerations. Overall, the country's AI strategy has positioned it as a leader in the field, and its continued investments and advancements in AI will likely shape the future of the technology landscape.

3.3 CANADA

The Government of Canada is supporting the Canadian Institute for Advanced Research (CIFAR) with approximately CA$125 million to launch a Pan-Canadian AI Strategy. This strategy is providing a strategic retainment and attraction of a highly skilled academic workforce and talent. This is also expanding the number of post-graduate trainees and researchers studying AI. In this way, Canada is increasing the number of exceptional AI researchers and skilled graduates in Canada. Canada is also establishing interlinked nodes of scientific excellence in Canada's three major centres for AI in Edmonton, Montreal, and Toronto-Waterloo. This is to develop global thought leadership on the economic, ethical, policy and legal implications of AI advances, and support a national research community on AI. Canada is also fostering cooperation between AI research centres and industry.

Canada is also focused on inclusive growth, sustainable development, well-being, and human-centred values and fairness. This includes investing in AI research and development and building human capacity to prepare for the labour market transition. The relevant policy areas that are covered in the digital economy are education, employment, industry and entrepreneurship, innovation, science and technology, and social and welfare issues. Furthermore, the estimated budget expenditure range per year is between CA$20 million and CA$50 million.

The shifts in the policy initiatives have received strong public support for research programmes and highly skilled experts from Canadian universities. This has strengthened and propelled Canada's leadership in AI and deep learning research and applications. Consequently, Canada's skills, talent, and ideas are highly sought to harness AI benefits. To this end, Canada is strengthening their investments to approximately CA$125 million in 2017 to retain and attract top academic talent. This budget is also expanding the number of postgraduate trainees and researchers studying AI and deep learning. The Pan-Canadian AI Strategy for Research and Talent was launched to promote collaboration between Canada's main centres of expertise in Montréal, Toronto-Waterloo, and Edmonton. This is also to strengthen the leadership of Canada as a world-leading destination for companies seeking to innovate through AI technologies. Canada realises that expanding the pipeline of Canadian talent for AI technology will substantively benefit businesses in vital economic sectors.[9]

3.4 UNITED KINGDOM

The National AI Strategy under the Department for Digital, Culture, Media, and Sport (DCMS) and Department for Business, Energy & Industrial Strategy (BEIS) is building UK's strengths in AI technology. This also represents the start of a step-change for AI in the UK to recognise the strengthening of AI to enhance resilience, productivity, growth, and innovation within the private and public sectors. The UK is also investing in the long-term needs of the AI ecosystem to continue the UK's leadership as a science and AI superpower. This is also supporting the transition of the UK to an AI-enabled economy to comprehensively capture the benefits of innovation in the UK. This will also ensure the realisation of AI benefits in all economic sectors and regions. The UK is also ensuring national and international AI technology governance to encourage innovation, and investment, and protect the public and fundamental values.

[9] https://oecd.ai/en/dashboards/policy-initiatives/http:%2F%2Faipo.oecd.org%2F2021-data-policyInitiatives-14828.

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In 2021, the UK government launched its National AI Strategy to strengthen the 2018 AI Sector Deal. This strategy is building on the United Kingdom's 2017 Industrial Strategy that aspires to position the UK as a global centre for AI innovation. In April 2018, the UK's government and the country's AI ecosystem agreed to invest approximately GBP1 billion (EUR 1.16 billion) AI Sector Deal to bolster the UK's global position as a leader in developing AI technologies.

The strategic priorities include data access and sharing, data governance, connectivity and digitalisation, intensifying research, and development (R&D), facilitating experimentation in a controlled environment, addressing societal challenges to enhance social inclusiveness, and formulating sustainable environmental solutions. The clusters and regional support are including regional and local R&D investments and specific economic sectors such as industrial policy and R&D targets for clean technology. Technology transfers and commercialisation are also a priority including education and skills development and public research capabilities. The UK government is enhancing access to finance for innovation such as venture capital, business angels, and financial markets to strengthen business innovation, innovative entrepreneurship, and digital infrastructure for AI such as cloud resources and computing power. The UK government is also increasing public awareness and civic engagements to review and adapt existing policy and regulatory frameworks. There are efforts to enhance international cooperation on STI and AI policy governance to strengthen vertical and horizontal coordination and evaluation.

3.5 CHINA

The National New Generation AI Plan for China involves initiatives and goals for R&D, industrialisation, talent development, education and skills acquisition, standard setting and regulations, ethical norms, and security. China is aspiring on aligning the country's AI industry and enable the country to lead in some AI fields by 2025. This includes becoming the primary centre for AI innovation by 2030. As such, the Chinese government is ensuring that the AI industry should be worth RMB 1 trillion (EUR 130 billion) by 2030 and the related industries are worth over RMB 10 trillion (EUR 1300 billion). In addition, the Chinese government is also partnering with national technology companies to advance research and industrial leadership in specific fields of AI. As a result, China will invest over US$ 2.1 billion (EUR 1.8 billion) to build a technology park for AI research in Beijing.

The Plan has outlined a three-step strategy that is strategically guiding China to develop the world's most advanced level of AI technologies by 2030. By 2030, AI will become an important driver of economic growth as the value of the core AI industries will have grown to approximately RMB 150 billion (US$ 22 billion). The AI-related industries are estimated to reach RMB 1 trillion (US$ 140 billion) with several enterprises possessing world-leading competitiveness, especially in a series of technological breakthroughs. These industries include intelligent big data, intelligent cross-media, swarm intelligence, hybrid enhanced intelligence, and indigenous intelligent systems.

China is also aspiring by 2025, the country will be the world's leading level for some sets of AI technologies and their application and breakthroughs for fundamental AI theories. By then, AI should have been employed in areas such as smart manufacturing, smart healthcare, smart cities, smart agriculture, and national defence. The value of core AI industries will reach RMB 400 billion (US$ 50 billion), and the AI-related industries will reach approximately RMB 5 trillion (US$ 700 billion).

Further to this, China is planning that by the year 2025, the country will have established the preliminary legal framework for AI to include standards, safety assessments, and supervision. By 2030, China is aspiring to be leading the world in all levels of AI theories, technologies, and applications. China should also have become the global centre for AI technologies and AI economy with a value of core AI industries exceeding RMB 1 trillion (US$ 140 billion) and AI-related industries exceeding RMB 10 trillion (US$ 1.4 trillion. This includes deep and integrated applications for all product segments, social governance, and national security and defence, with a series of high-level AI technology innovation

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bases and talents leading globally.[10] As such, strategically, China is prioritising AI policy governance to strengthen vertical and horizontal coordination and evaluation. The specific economic sectors include developing industrial policy, R&D targets for clean technology, and R&D intensity.

3.6 SOUTH KOREA

The National Strategy for AI is focused on developing AI with cognitive, learning, and reasoning capabilities to enhance the productivity, safety, and convenience of people. The Korean government launched the National Strategy for AI on December 17th, 2019. The vision of 'Toward AI World Leader beyond IT', Korea aspires to accomplish digital competitiveness, generate enormous economic effects of AI, and enhance the quality of life for people by 2030. The strategy consists of 100 government-wide action tasks under specific economic strategies within the AI ecosystem, AI utilisation, and people-centred AI.

3.7 UNITED ARABIC EMIRATES

The United Arabic Emirates (UAE) is implementing AI through the AI Strategy to become the world leader in AI by 2031. To implement this vision, UAE is substantively outlining a path of strategic objectives and developmental initiatives. The country's AI Strategy is aligning with the UAE Centennial 2071, to make the UAE the best country in the world by 2071. Fundamentally, the AI Strategy is significantly contributing to education, the economy, government development, and community happiness. This AI technology strategy is being implemented in various economic sectors such as energy, tourism, and education, among others. Additionally, the UAE AI and Blockchain Council's oversight is on the implementation of the AI Strategy throughout all emirates. Ultimately, the AI implementation is undertaken through multi-stakeholder efforts and cooperation from various local and federal entities in the UAE.

Strategically, the UAE's AI Strategy is building a reputation as an AI destination to increase the UAE's competitive assets in priority economic sectors through the deployment of AI. Furthermore, the UAE is developing a fertile ecosystem for AI and adopting AI across customer services to advance lives and government. This is also aimed at attracting and training talent for future jobs enabled by AI and bringing world-leading research capability to work with target industries. This includes providing the data and supporting infrastructure that is essential to becoming a test bed for AI and ensuring strong governance and effective regulation.

The UAE has a robust foundation to facilitate a cohesive and diversified multinational community that can accelerate the adaptation of new and emerging technologies. This is also attracting the best talents from the globe to perform their experiments on AI solutions in the UAE and ensure practical AI implementations in different economic sectors. For example, cybersecurity has been identified as a strategic imperative based on the demand for AI applications in the UAE to build robust systems for cyber security and protection. These economic sectors are selected based on the potential of AI economy deployment and potential disruptions. For example, there are potential gains of approximately AED 136 billion (US$ 37 billion) in services and trade sectors to strengthen tourism as a priority sector. Consequently, the growth of AI in this growing consumer-facing sector could potentially spill over into other service sectors. Furthermore, approximately AED 91 billion (US$ 20 billion) in resources and utilities were contributed to making energy a priority, and AED 19 billion (US$ 5 billion) in logistics.

The global economic gains based on automation technologies are estimated between 0.3% and 2.2 % growth in compound annual productivity. As such, the PwC has estimated that AI will contribute approximately AED 353 billion (US$ 96 billion) to UAE's GDP by 2030, constituting 13.6% of the total GDP. Therefore, the gains from heightened performance will outweigh those that come from

[10] https://oecd.ai/en/dashboards/policy-initiatives/http:%2F%2Faipo.oecd.org%2F2021-data-policyInitiatives-24274

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replacing labour with machines in some economic sectors and this will significantly impact the young and resource-rich economies of the Middle East.

3.8 SAUDI ARABIA

The Saudi Data and AI Authority (SDAIA) within the Ministry of Communications and Information Technology (MCIT) aspires to make the country a global leader in AI by 2030. Saudi Arabia is working on launching AI and data-related initiatives and events, implementing national a multi-tier data and AI workforce certification programme, and establishing a data and AI focus in the educational system. Saudi Arabia is also activating regulatory frameworks for data and AI activities and incentive schemes to attract data and AI companies and talents. This is also to build targeted funds and investor support programmes to attract and guide domestic and foreign investments in data and AI. Saudi Arabia is also elevating data institutions' innovation, quality, and commercialisation outcomes, and establishing testbeds in new cities. Most importantly, Saudi Arabia is building an integrated infrastructure, and establishing data and AI platforms to accelerate the adoption of data and AI applications.

Saudi Arabia is strategically prioritising business innovation and innovative entrepreneurship, education and skills, international cooperation on STI, and R&D intensity. The implementation mechanism has a dedicated coordinating and monitoring public body to undertake problem definition, policy objective formulation, and policy design. The Saudi government aims to ensure data is captured in readable formats to start publishing comprehensive datasets across government entities after 2025.

3.9 MAURITIUS

Mauritius was the first African country to publish an AI strategy document, publishing their Mauritius AI Strategy in 2018 as a report of the National Working Group on AI. The document sets out a vision for AI as creating a new pillar for the development of our nation', advancing socioeconomic growth across key sectors. A series of priority AI areas were identified, with extensive suggestions for potential applications and scoping of existing projects. These priority areas are manufacturing, healthcare, financial technology, and agriculture. Two further areas include AI in the Ocean Economy with smart ports and traffic management and AI in energy management to contribute to reducing CO_2 emissions. The close of the report sets out a series of recommendations including provisions for skills development, research and development funding, and governance mechanisms such as data protection, open data platforms, and the establishment of an AI ethics committee.

Mauritius' AI Strategy has positioned AI to be the cornerstone of the country's next development model. The strategy is providing a roadmap to define the key considerations for developing the appropriate AI ecosystem to enable Mauritius to adopt emerging technologies as growth enablers. The strategy focuses on prioritising economic sectors and identifying national projects, capacity building and attracting skills, and incentivising the private sector to fast-track AI implementation. The ethical considerations of AI, development of strategic alliances in emerging technologies, sensitisation campaigns, and the adoption of new technologies for enhanced delivery of public services.

The strategy was formulated and launched to ensure that the strategic recommendations for AI and other emerging technologies provide the required economic and social impacts in Mauritius. These include developing a coordinating body, namely the Mauritius AI Council, to facilitate stakeholder engagements and have oversight on the implementation of AI-related projects. This can provide funding and incentives such as matching grants, tax credits, fiscal incentives, equity financing, training grants, and investment of profits into AI to support start-up companies in AI and financial technology.

Developing skills capacity by having expertise engagements and campaigns can help set up AI campuses for training purposes to undertake tailor-made programmes. These programmes can be

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supported by local universities and have international experts supporting them in the medium term until enough expertise has been developed in Mauritius. Mauritius government is also reviewing the existing elective modules at universities to make programming and coding mandatory for all subjects. However, this requires adequate investments in STEM education, national training programmes, and lifelong learning.

The projects that are being proposed to support the AI strategy include making use of blockchain technology to make tax payments, land registration, and manage health insurance. The country is also utilising AI to improve the energy sector and bolster efficiency and competitiveness in the manufacturing sector. The country is also using AI to leapfrog their healthcare system, develop the biotechnology industry, employ an AI-based agricultural industry, and strengthen the ocean economy and transportation.

The AI strategy is also highlighting essential issues that are related to the legal and regulatory frameworks, and ethics and data protection for AI in Mauritius. This includes recommendations to accelerate the Intellectual Property Bill, updating AI regulations to advance financial technology, mobile money payments, crowdfunding, and crowdlending. Mauritius is also ensuring an ethical and responsible AI system by establishing a permanent committee to administer ethics and develop a special working group. This special working group will execute the necessary amendments to data protection legislation and recalibrate the policy frameworks focused on open data access.[11]

3.10 KENYA

Kenya has AI use cases in the public sector that facilitate the initiatives using AI in Kenya's public sector. The use in public sector has designed a smart city using the Konza Technopolis. This is a smart city designed and implemented by the Kenyan government to enhance Kenya’s innovation ecosystem and digital economy. This is accomplished by providing the missing infrastructural and technological links that can potentially advance Kenya’s economic activities. The first phase of the Technopolis was implemented between 2017 and 2022 through the development of the Horizontal Infrastructure and Subsurface Utilities, the construction of the Konza Complex, and the construction of the Konza National Data Centre and Smart City Facilities. The establishment of the Kenya Advanced Institute of Science and Technology (KAIST) was among the other priority projects that would a attract skilled workforce and enhance recruitment of skilled labour and strengthen investments through the Investor Outreach programme.

The Blockchain AND AI Task Force was launched in February 2018 under the Ministry of Information and Communications to provide the government with recommendations on the best practice for harnessing AI and blockchain technologies over the next few years. The members of the task force are from academia and industry to recommend the application of these technologies in public service delivery, cybersecurity, financial inclusion, and election processes. To this end, the task force published a report entitled, “Emerging Digital Technologies for Kenya: Exploration and Analysis”, in 2019. The report highlighted the importance of Kenya’s investments to support the ecosystem and further develop effective regulations to balance citizen protection and private sector innovation.

3.11 SOUTH AFRICA

The Presidential Commission on Fourth Industrial Revolution (4IR) was launched by the South African government in 2019. The Presidential Commission on Fourth Industrial Revolution consists of leaders from academia, business, and civil society. This commission was instituted to enable South Africa to create a shared Fourth Industrial Revolution future through inclusive growth, sustainable development, and well-being. The commission started working in May 2019 to consolidate research and stakeholder engagements so to generate a comprehensive view of South Africa’s current 4IR-based socioeconomic

[11] https://tradecca.thecommonwealth.org/pdf/mauritius-artificial-intelligence-ai-strategy-mm#:~:text=Mauritius'%20AI%20Strategy%20sets%20out,technologies%20as%20enablers%20of%20growth.

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development outlook and the necessary policy initiative structural reforms. This was undertaken through stakeholder engagements to influence policy implementation, design, objective formulation, and problem definition.

3.12 GHANA

The National AI Strategies for Inclusive and Sustainable Development is supporting the development of 3 National AI Strategies in Africa with key public sector partners, GIZ and Smart Africa. These programmes are building an AI capacity through AI policy, regulatory, and governance frameworks to support Africa's efforts to harness responsible AI. These are to accomplish national objectives and inclusive and sustainable development goals. As such, between 2020 and 2022, there were efforts to support the development of 3 National AI Strategies in Africa with key public sector Ministries, GIZ, and Smart Africa. These were Rwanda's National AI Policy, Tunisia's National AI Strategy, and Ghana's National AI Strategy.

Based on extensive local stakeholder engagements and consultations, the recommendation outputs were tailored towards responsible and enabling AI. These were to strengthen policies, implementation plans, SWOT analyses of local AI ecosystems, AI ethical guidelines, and recommendations for the establishment of programme offices to drive implementation frameworks and plans. The projects are capacity-building to support countries' efforts to harness AI responsibly to accomplish national objectives and inclusive and sustainable development goals.

In August 2022, Ghana's Data Protection Commission in partnership with The Future Society (TFS), GIZ FAIR Forward, and Smart Africa convened the third high-level public sector consultation workshop to evaluate, assess, and validate the AI draft recommendations. These cross-ministerial and cross-sectoral policies aspire for responsible AI adoption in Ghana for sustainable and inclusive growth. As such, Ghana's Ministry of Communications and Digitalisation is steering the development of the government's National AI Strategy. This is building on existing digital policies, a national AI strategy and an action plan, that will support Ghana's AI ecosystem and governance. The project is strengthening Ghana's capacity to harness responsible AI for socioeconomic development and growth.

3.13 TUNISIA

The Ministry of Industry, Mines and Energy (MIEM; Ministère de l'Industrie et des Petites et Moyennes Entreprises) is responsible for the initiative groups for several AI use cases in the Tunisian public sector. Tunisia's AI Roadmap has undertaken industrial and entrepreneurship awareness such as the Tunisian startup InstaDeep awareness and training campaign about AI for government officials. This ongoing campaign aspires to strengthen the capacity of 10,000 governmental agents over three years. This was to raise endless AI applications in public administration and enhance AI system transparency.

Tunisia's AI incorporated industry, entrepreneurship, innovation, science, and technology in performing internal functions in government and enhancing communication as a business function in the public sector. The awareness campaigns are involving various stakeholders such as the academia, private sector, civil society, trade unions, non-governmental organisations, and industry in the development and implementation of the AI initiatives. The AI capacity-building activities include STEM Education to strengthen programmes such as early education programmes, digital skills strategies, technology, and data literacy education programmes.

The Ministry of Industry and SMEs launched a cooperation campaign with GIZ an AI project to develop an OCR algorithm. This algorithm can digitalise Arabic typing and further create a text database for the deliberations of the parliament since its creation. Tunisia has also launched projects of customer service chatbots that answer FAQs, direct requests to the appropriate area within government and public service

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and assist with searching documents. These included the Agency for the Promotion of Industry and Innovation (APII) Chatbot, Industry Upgrade Programme (PMN) Chatbot, National Research and Innovation Program (PNRI) Chatbot, National Trade Registry (RNE) Chatbot, Chatbot for Customs Office, and Customer Service Chatbots.

In applied research, there are various science and innovation challenges, prizes, and awards that were organised by the Tunisia government in September 2019 in collaboration with Insta Deep and Google. For example, an AI hackathon entitled "AI Hack Tunisia 2019" was organised for approximately 1,200 people from 23 countries and about 50 international AI experts. The themes dealt with real data drawn from the challenges of Tunisian administrations and companies.

In addition, Tunisia organised a "Transition on the Way" as the theme of the second edition of the "Smart Industry 2020" in February 2020, in Tunis. The event was organising d by the Agency for the Promotion of Industry and Innovation (APII), in cooperation with the Ministry of Industry and SMEs, the German Agency for International Co-operation (GIZ), and the Tunisian Confederation of Industry, Trade and Handicrafts (UTICA). The event focused on the importance of promoting and financing mechanisms for Industry 4.0 and AI for the Tunisian ecosystem.

The Ministry of Industry and SMEs also signed an agreement for cooperation and partnership to contribute to the promotion of emerging technologies such as AI in July 2020. This was undertaken with the Tunis Afrique Presse Agency (TAP) to undertake training programmes on Innovation and AI for journalists, and developing content on Science, Technology, and Innovation. Additionally, to enhance public awareness campaigns and civic participation activities, the Ministry of Industry and SMEs in collaboration with Innovi-EU4Innovation on a July 2020 webinar deliberated on AI as an instrument for economic recovery in Tunisia. This webinar convened a group of Tunisian and international AI experts and AI start-up companies to define the role of innovative technology in preparation to mitigate the COVID-19 economic challenges. The discussion also deliberated on the prospects for the development of Tunisian AI internationally, the development of ethical and responsible AI, and AI as an instrument for economic recovery in Tunisia.

3.14 EGYPT

Egypt published and implemented a comprehensive National AI Strategy in July 2021. The strategy is ensuring that AI adoption and solutions can contribute to realising Egypt's national developmental priorities. The strategy is also addressing human rights concerning mass government surveillance and censorship. The strategy aspires to advance governmental AI-based service delivery to improve efficiencies, transparency, and decision-making. This is to advance the usage of AI in the public and private sectors to build AI capabilities in education, skills development, and research, and strengthen international and regional cooperation around AI through bilateral partnerships and shared commitments.

On the other hand, AI governance is being enabled by suitable laws, policies, and ethical and technical guidance. The data should also be protected through the Personal Data Protection Law that was enacted in 2020. Egypt is yet to develop the data strategy and infrastructure to strengthen cloud computing and data storage. The AI ecosystems can be heightened through institutions, start-up companies, and skills development to ensure a responsible and innovative national AI ecosystem.

Since Egypt is embracing the digital era and the advances in emerging technologies, the country is actively creating essential economic opportunities. AI necessitates intensifying efforts to adopt such technologies and develop strategies to utilise these technologies to improve Egyptians' quality of life. Therefore, the National Council for AI has developed a comprehensive national plan to indigenize the AI industry and strengthen Egypt's leading role at the regional level to actively lead in the AI field. This includes promoting effective public-private partnerships to heighten innovation and support building Digital Egypt to accomplish AI-based digital transformation. Such efforts are encouraging

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investment in AI-based R&D and developing human capital to develop AI applications in alignment with the national needs and Egypt's priorities.

3.15 RWANDA

Rwanda has become one of the first countries in Africa to develop a national AI policy, recognising the potential of AI to drive innovation, economic growth, and social development. The policy, launched in 2019, aims to position Rwanda as a regional hub for AI innovation and attract foreign investment. It includes plans to develop AI infrastructure, support the development of AI skills and talent, and foster a culture of innovation and entrepreneurship. The policy also emphasizes the importance of ethical and responsible AI development, with a focus on promoting social inclusion and addressing potential risks.

In terms of infrastructure, Rwanda has made significant investments in ICT infrastructure, including fibre-optic networks, 4G LTE coverage, and a national data centre. The country has also launched a series of initiatives to promote the development of AI skills, including a national coding program that provides free coding classes to young people. The government has also partnered with private sector companies to develop AI applications for healthcare, agriculture, and other sectors.

Rwanda's implementation strategy has focused on developing partnerships with international organisations and companies to support AI research and development. The country has also launched a series of AI-focused initiatives, including a national AI centre and an AI-powered drone delivery system for medical supplies. Rwanda has also been active in international discussions on AI governance and ethical considerations and has called for greater investment in AI research and development across the continent. Overall, Rwanda's national AI policy has positioned it as a leader in AI innovation in Africa, and its continued investments and advancements in AI are likely to have a significant impact on the country's future development.[12]

3.16 SENEGAL

Senegal has formulated a National Data Governance Strategy focusing on digital identity and data governance to establish AI-based governance.[13] This is also heightening the digital ecosystem and data protection by outlining the principles of governance and harmonising stakeholder engagements to influence innovation, digital trust, the protection of fundamental rights and economic development. This is also encompassing the development of infrastructure and markets of the economy.

Senegal is also implementing the data governance policy to strengthen digital sovereignty and the acquisition of a major infrastructure known as the DATA supercomputer. This DATA supercomputer has the power of 537 teraflops and an integrated storage capacity of 956 terabytes data centre is a type of Tier 3. This infrastructure is to ensure that the hosting can sufficiently secure the most critical data. Currently, through the data storage infrastructure, Senegal is instituting efforts to ensure the transfer of data from abroad into the country. Senegal is also strengthening its cybersecurity, curbing cybercrime, and enhancing cyber defence:

There are efforts to heighten AI awareness, reduce data manipulation, enhancing stakeholder cooperation, developing AI ethics and responsible AI, strengthening AI legislation, and heightening transparency, security, and AI safety. Furthermore, Senegal is enacting a Data Protection Flagship to develop guidelines on the protection of personal data, harmonise legislation, and strengthen institutional data protection cooperation.

[12] https://oecd.ai/en/dashboards/policy-initiatives/http:%2F%2Faipo.oecd.org%2F2021-data-policyInitiatives-27391.
[13] https://www.actuia.com/actualite/afrique-le-senegal-envisage-une-strategie-nationale-de-gouvernance-de-la-donnee/.

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3.17 SUMMARY OF NATIONA AI STRATEGIES

AUDA-NEPAD and APET realise that Africa has been lagging in the development of AI when compared to other continents. Thus, to bridge this gap, it is crucial to develop and implement an AI continental strategy for Africa. This strategy should prioritise human capital development in AI by providing training and education opportunities to Africans. This will enable the continent to have a skilled workforce that can create and implement AI solutions to address African challenges.

Additionally, an AI continental strategy for Africa should focus on developing infrastructure and use for AI. This will require investing in the necessary technology infrastructure such as high-speed internet, data storage, and cloud computing. African countries can also leverage existing AI technologies to solve local problems, for example, AI-powered agriculture to improve food security.

Creating an enabling environment for AI technology is another critical aspect of the strategy. Governments in Africa can support AI research and development through funding, regulation, and policies that support innovation. Governments should also ensure that ethical and legal frameworks are in place to guide the development and use of AI. This will foster public trust in AI technology, which is crucial for its adoption and success.

Moreover, an AI continental strategy for Africa should prioritise strengthening AI economic activities. African governments can create incentives and initiatives to attract AI investments and start-up companies to the continent. This will help create job opportunities and promote economic growth through the creation of AI-based products and services.

Finally, building sustainable partnerships is essential to the success of the AI continental strategy for Africa. African countries can partner with international organisations, governments, and businesses to leverage their expertise and resources in developing and implementing AI solutions. This will help accelerate the growth of AI in Africa and promote its integration into the global AI ecosystem.

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4 PILLAR 1: HUMAN CAPITAL DEVELOPMENT FOR AI

4.1 INTRODUCTION

The world is currently in the era of the fourth industrial revolution. The previous three industrial revolutions were driven by invention, advancements, and usage of steam power, electricity, semiconductors, and computer technology respectively. Every industrial revolution brings about a change in society. The fourth industrial revolution, often referred to as 4IR or Industry 4.0, is driven by the advancements of various technologies such as artificial intelligence (AI), next-generation medicine or precision medicine, gene drives, next-generation batteries, gene editing, microgrids, and 3D printing. Drones and their applications in various fields, such as precision agriculture and logistics, among others, are another set of 4IR technologies.[14]

AI technology is one of the main drivers and the most discussed technologies of the fourth industrial revolution. There has been a tremendous uptake and widespread application of AI by various sectors, such as financial technology, education, transportation, logistics, and medical support. Though various AI algorithms have existed for over half a century, a lack of availability of large amounts of data in digital format and limited computational resources has led to the limited uptake of the technology in the past. The growth in the usage of digital devices, mainly mobile or smartphones, across the globe, motivated companies to introduce digital channels to interact and provide services to their customers leading to the generation of large amounts of data. Social media platforms are another such source that generates huge amounts of data. Recent developments in cloud computing have further made computational resources affordable, thus leading to a widespread uptake and usage of AI technology by various economic sectors.[15]

Knowingly or unknowingly, we have already started to interact with the various applications of AI in our daily life. For example, chatbots, online language translators, and virtual personal assistants, among others, utilise AI engines in the background. Soon, we are likely to interact even more with such AI-driven applications daily. This is because the application and usage of AI technologies in various sectors of the economy make systems and processes more effective and efficient thereby contributing to the growth of the economy.[16] To gain the most out of this new technology, nations and continents need to have a well-defined strategy. Various countries around the world have already developed or started to develop strategies in this regard. While developing a national or continental strategy for AI the landscape concerning the infrastructure, connectivity, data foundation, and human capital, among others, needs to be considered. Any nation or continent can take advantage of this AI-driven revolution if it actively participates and contributes to the development of innovative AI products, and this can be made possible with an empowered human capital which can develop and/or interact with AI products.[17]

Statistics show that Africa is the world's youngest continent. In 2020, three out of five Africans were below the age of twenty-five. Furthermore, it is expected that by the year 2050, approximately 50% of Africans will be below the age of twenty-five; and a billion children and adolescents under eighteen years of age. Though this pool of young population is a huge opportunity for Africa, this will not last forever. To take advantage of this young population to move the continent forward, Africa needs to develop and implement policies that will adequately empower the current and future young population of Africa. The policies should aim to address some of the current issues which may hinder taking advantage of this huge population of young individuals and the future workforce. For example, studies show that 87% of children in Africa are unable to read, understand, and simple text by the age of ten.[18] Studies have also highlighted that 38% of youth in Africa want to permanently relocate to other countries, such as the developed world.[19] Therefore, there is a need to create a conducive socioeconomic environment for the young population of Africa by accelerating investments in human capital development and preparing the young population for the work of the future.

[14] https://www.nepad.org/microsite/African-Union-high-level-panel-emerging-technologies-apet.
[15] https://www.weforum.org/agenda/2020/10/africa-needs-digital-skills-across-the-economy-not-just-tech-sector/
[16] OECD. 2018d. Main Science and Technology Indicators Database. Available at: http://www.oecd.org/sti/msti.htm
[17] https://www.unicef.org/reports/transforming-education-africa
[18] https://blogs.worldbank.org/education/reducing-learning-poverty-through-country-led-approach
[19] https://www.afdb.org/en/topics-and-sectors/sectors/human-capital-development

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4.2 GOALS AND TARGETS

This pillar intends to understand the existing continental frameworks on human capital development and to enhance them, assess the current AI skills gap within the African continent and examine AI's potential for changing the future of work in Africa. The pillar reviews the state of the educational curriculum in preparing an AI workforce and proposes a new approach to research, development and innovation in AI. The proposed strategy for human capital development in AI in Africa aims to build up the skills and knowledge of the African workforce in AI-related fields. This involves initiatives such as training programmes, educational partnerships with international institutions, and the development of AI-focused research and innovation hubs across the continent.

The pillar identifies priority stakeholders and proposes programmes to bridge the skills gap for these various stakeholders, with a focus on short, medium, and long-term strategies for AI human capacity development, and a focus on building the human capital strength of Africa. It works to ensure that AI technologies are developed and deployed in a way that benefits African societies and economies. This involves promoting the use of AI in areas such as healthcare, agriculture, and infrastructure development, and ensuring that these technologies are designed to be accessible and useful to a broad range of people, including those in rural or marginalized communities.

Finally, the pillar seeks to foster collaboration and partnerships between African countries, as well as between African and international organisations. This involves sharing expertise and resources, coordinating research and development efforts, and leveraging the power of AI to address common challenges facing the continent, such as poverty, inequality, and climate change.

4.3 CONTINENTAL FRAMEWORKS ON HUMAN CAPITAL DEVELOPMENT

The current wind of change for the continent of Africa is digital transformation. The aim behind this revolution is for Africa to be an equal partner at the global level to participate in the socioeconomic activities that are derivatives of technological advancement.[20] Africa and in particular, the African Member States, should also become the producer-consumer of technological products and services. We consider that each country has its unique context which should be considered. Given that 70% of Kenyan residents have access to broadband internet, Kenya is well-suited for all levels of digital skills training. The actual usage of the internet is however constrained by high data costs, a lack of basic education, and a dearth of locally relevant material.[21]

In Nigeria, it would be crucial to strengthen the power infrastructure because only 35% of schools are linked to a power supply, and that supply is, to put it mildly, inconsistent. Remarkably, the standard and degree of digital skills are influenced by the entire effectiveness of the educational system, including primary and secondary school. In tandem with the foregoing discussions, many continental frameworks have been incubated to catalyse technological adoption.[22]

PRIDA aims to enable the African continent to benefit fully from digitalisation and build the capacity of African Union (AU) Member States in the internet governance space. The programme is a joint initiative of the AU, the EU, and the International Telecommunication Union (ITU). The framework is primarily concerned with issues of network infrastructure connectivity including harmonised spectrum licensing, reframing, and pricing.[23] This should be an impetus for generating social and economic benefits for people and the private sector to ensure sustainable growth. Furthermore, the framework seeks to promote a

[20] GII. 2018. Global Innovation Index 2018: Energizing the World with Innovation. Cornell University, INSEAD, and WIPO, Ithaca, Fontainebleau, and Geneva. Available at: https://www.globalinnovationindex.org/gii-2018-report
[21] https://www.anchorsoftacademy.com
[22] Forbes. 2018. Global 2000: The World's Largest Public Companies. Available at: https://www.forbes.com/global2000/#3be737e7335d
[23] Fortune. 2018. Fortune 500. Available at http://fortune.com/fortune500/list/.

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conducive environment for digital transformation and Internet governance. With these African stakeholders will benefit from improved healthcare, education, and agriculture.[24]

Another framework that has shown a positive impact is the Programme for Infrastructure Development in Africa (PIDA). The framework was meant to address infrastructure challenges that stall the continent from sustainable competition on the world market.[25] Accordingly, this can be achieved by developing a common infrastructure for integrated transport, energy, ICT, and transboundary water networks to stimulate among African stakeholders, job creation, and free trade, and consequently, would both change and improve the way business is conducted. The net result should be a well-connected Africa that could realise the building of a strong African Economic Community.[26] If the framework is well implemented, ICT's contribution to GDP will double from 5% to 10% by 2025.

The African Continental Free Trade Area (AfCFTA) was founded in March 2018 and was signed by forty-four Member States out of fifty-five. The rationale is to pull together the national resources for each of the Member States and create a continental pool of resources for the socioeconomic benefit of the people of Africa. There will be a removal of tariff and non-tariff trade barriers amongst African countries, thus accelerating the levels of intra-African trade. The ultimate vision is to boost Africa's rate of industrialization, technological innovation, and competitiveness, promoting regional value chains to foster integration. The proponents argue that this will translate into economic growth and social progress.

The African Union Financial Institutions (AUFIs) proposed that there should be economic integration as espoused by the Abuja Treaty of 1991. The idea is to build with AfCFTA, an African Economic Community. Thus, the framework advocate for the creation of financial institutions such as the African Central Bank (ACB), the African Investment Bank (AIB) and the African Monetary Fund (AMF), that promote exchange stability and avoid competitive exchange rates and help establish a multilateral system of payments in between members and eliminate foreign exchange restrictions that inhibit the growth of world trade. It is also necessary to take cognisance of the discussions that have been made around coming up with the Single African Air Transport Market (SAATM); and the Free Movement of Persons (FMP). for the African, Union this will help create a Single Digital Market for Africa.

Looking at all these initiatives and frameworks that have been put in place, the aim to deliver a smart Africa can only be realised much faster with technological enablement. The sound adoption of ICTs and the power of AI will catapult the achievement of the tenets of these numerous initiatives. There are quick gains if these frameworks prioritise human capital development, especially taking advantage of Africa's young population and upskilling them with ICT and STEM-related skills. Africa should invest in itself to take advantage of the growing population. According to Union, African (2015), it is predicted that by 2040, there will be more than 100 cities with over a million residents with 7 of them having more than 10 million. It is imperative to take advantage of this population growth as it acts as the reservoir of manpower for our industries and commerce. Suggestions could be made to develop more Innovation and Incubation Hubs to develop and mature technology skills in our youths for the future of Africa. Our governments should play crucial roles in providing conducive and enabling environments that promote digital inclusion by making all pockets of our societies reachable for rolling Internet access. This is going to be a stimulus to offer technology training from anywhere anytime and this will result in an increase in the workforce for the targeted African digital market. From this vantage point, the African continent will become an equal partner with the rest of the world to take advantage of the opportunities emanating from emerging technologies such as AI in the 4IR.

[24] OECD. 2018f. PISA 2015 Results in Focus. Paris: OECD Publishing. Available at: https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf.
[25] Frank, Robert H. 2017. Success and Luck — Good Fortune and the Myth of Meritocracy. Oxford: Princeton University Press.
[26] Gartner. 2018. Gartner's Top 10 Strategic Technology Trends for 2018. Contributed by Panetta, Kasey. Available at: https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2018/

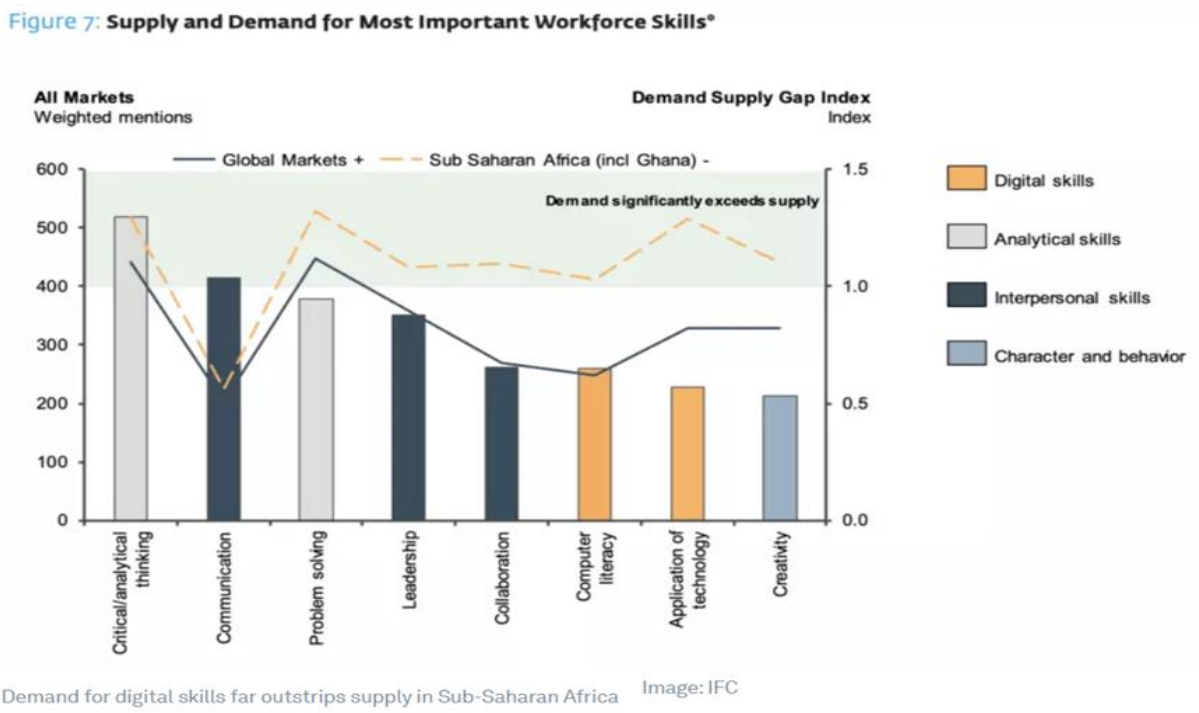

Figure 1. Supply and demand for most important workforce skills

Although children's attendance at school has grown across Africa as shown in Figure 2, the authors hypothesize that, given the continent's fast population expansion, the real number of unschooled children has increased since 2010.

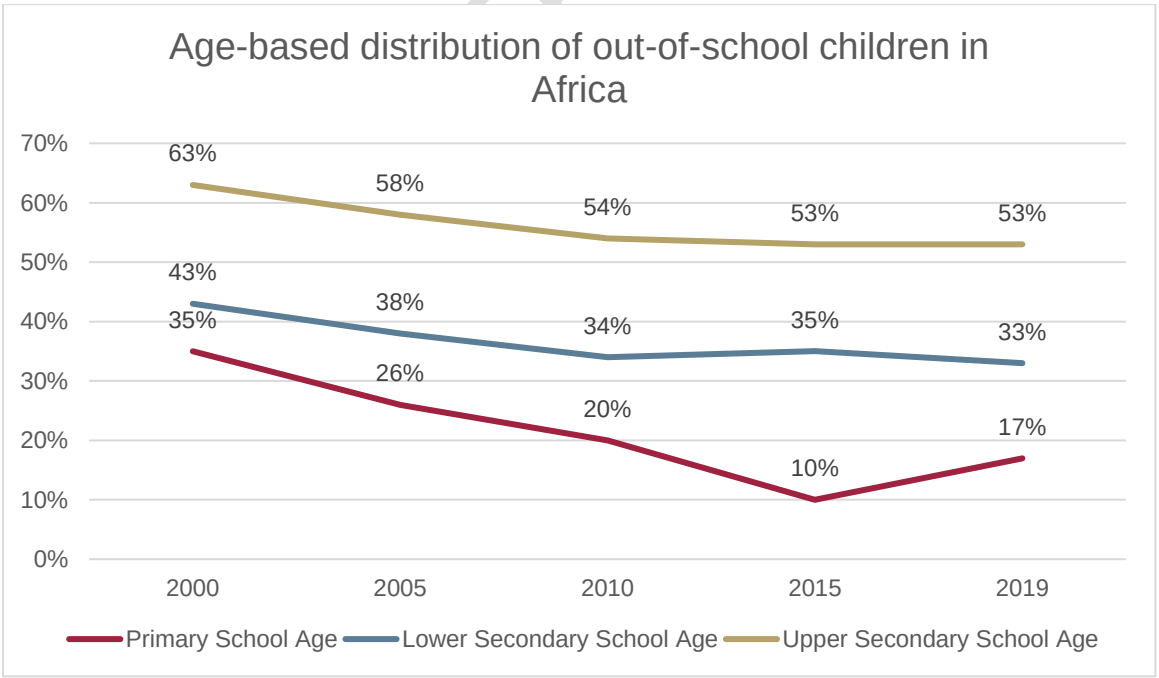

Figure 2. Out of school children in Africa by age group, chart created from data from the UNESCO Institute for Statistics and referenced from the report *"Transforming Education in Africa," African Union, 2021.*

Table 1. Region-based literacy rate of the rural population within Africa. Table created from data based on UNESCO Institute of Statistics

Region	% Rural Population, 2019	Adult Literacy Rate (%), 2018
Central Africa	46.2	67.5
Eastern Africa	64.0	71.1
Northern Africa	36.2	71.8
Southern Africa	56.3	78.7
Western Africa	54.1	51.5
Africa	53.6	66.0

According to the data presented in Table 1, Africa has varying levels of rural population and adult literacy rates across its different regions. Worth noting is that Central Africa has the highest percentage of rural population at 46.2% but a relatively lower adult literacy rate of 67.5%. On the other hand, Eastern Africa has a higher rural population of 64.0% and a slightly higher adult literacy rate of 71.1%. Northern Africa has a lower rural population of 36.2% but a relatively higher adult literacy rate of 71.8%. Furthermore, Southern Africa has a moderate rural population of 56.3% and a relatively higher adult literacy rate of 78.7%.[27] Western Africa has a similar rural population to Southern Africa at 54.1% but a significantly lower adult literacy rate of 51.5%. Overall, Africa has an average rural population of 53.6% and an adult literacy rate of 66.0%. Looking ahead to 2030, it is estimated that Africa will need approximately 17 million teachers to ensure access to elementary and secondary education for all its citizens. This highlights the significant challenge faced in meeting the educational needs of the continent's growing population.[28]

4.4 ONGOING ACTIVITIES ACROSS THE AFRICAN CONTINENT

An AI technology company called Data Science Network, formerly known as Data Science Nigeria, is dedicated to creating an ecosystem of AI talent in Africa and creating solutions for government, education, health, retail, and finance. In addition to developing AI solutions to improve the quality of life for 2 billion people in emerging markets, accelerating AI start-ups, and kicking off digital transformation for organisations in Africa, our mission is to develop 1 million AI talent in Nigeria and prepare them for the future of work.[29] By bringing together students, professionals, and public and commercial stakeholders to discuss and work on machine learning, data science, data analysis, and robotics technologies and solutions in the region, AI Kenya makes AI accessible to everyone. Furthermore, the Digital Literacy Programme, as the initiative is often known, aims to provide 20 million Kenyans with the necessary digital skills to function effectively in the digital economy.[30]

[27] GEM. 2018. Global Entrepreneurship Monitor Global Report 2017/18. Available at: https://www.gemconsortium.org/report
[28] Economic Strategy Tables. 2018. The Innovation and Competitiveness Imperative — Seizing Opportunities for Growth. Available at: https://www.ic.gc.ca/eic/site/098.nsf/vwapj/ISEDC_SeizingOpportunites.pdf/US$file/ISEDC_SeizingOpportunites.pdf
[29] https://www.universityworldnews.com.
[30] Choi, Jieun, Mark A. Dutz, and Zainab Usman, eds. The future of work in Africa: Harnessing the potential of digital technologies for all. World Bank Publications, 2020.

4.5 PILLARS FOR THE DEVELOPMENT OF CONTINENTAL HUMAN CAPITAL

4.5.1 ENABLER 1: RESEARCH COMMUNITY, INDUSTRY, AND GOVERNMENT

To facilitate the creation and implementation of AI solutions, the research community, industry, and government play significant interrelated roles.[31] Africa should expand its relationships with these stakeholders to bolster its collective capacities and advance the continent's overall national AI initiative.[32] Thus, the key objective should be to deepen investments in AI-related Research and Development across the research ecosystem across the African continent.[33]

This portfolio balances:

a) Game-changing fundamental research

b) Research that enables more widespread adoption of AI (e.g., collaborative, and human-centred AI, and digital trust technologies)

c) Applied research targeted at the needs of the key sectors of economies. Some countries in Africa have recognized research institutes that have ranked well in the world based on the impact of AI scientific publications.

African governments should commit over US$500m for AI-related research, innovation, and enterprise activities under the Plan and will invest more going forward. The three main pillars of AI Research, AI Technology, and AI Innovation will serve as the foundation for this body's activity. AI Research intends to establish strong AI research capacities in Africa, create the newest AI methods and algorithms, and establish Africa as a major player on the international stage.[34]

4.5.2 ENABLER 2: TALENT AND AI EDUCATION

Africa needs a range of multidisciplinary talents and skills in AI, digital technology, and business domain to develop and deploy AI solutions to the key sectors:

a) Research and Development – AI researchers and scientists with relevant industry or corporate research and development experience.

b) Data Engineering – Data engineers and technicians with experience in using data to continually develop and improve AI solutions.

c) Product Development – AI engineers, translators, and developers who can design and build user-centric products to drive large-scale adoption; and

d) Implementation – Application developers, infrastructure engineers, developers, and systems integrators with experience in building and operating large-scale machine learning systems.

4.5.3 ENABLER 3: SUPERCLUSTERS

[31] TRANSFORMING EDUCATION IN AFRICA: An evidence-based overview and recommendations for long-term improvements, A report by UNICEF and African Union Commission.
[32] Harrington, Lisa. 2013. Consumer as Disrupter: Managing the Fit-for-purpose retail and consumer goods supply chain. DHL Supply Chain White Paper. Available at: http://supplychain.dhl.com/consumer-resilience
[33] https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/07/GSMA_ATInnovation-Landscape_28pp_FINAL_Accessible_WEB.pdf.
[34] https://www.shrm.org/resourcesandtools/tools-and-samples/hr-qa/pages/what-is-meant-by-the-future-of-work.aspx#:~:text=Simply%20put%2C%20the%20future%20of,they%20prepare%20for%20the%20future

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Inspired by the Canadian Government's Global Innovation Cluster initiative to help build innovation ecosystems throughout their country, African governments can take inspiration from this to form their own set of clusters.[35] Canada's Innovation Clusters are split into 5 groups: Digital Technology, Protein Industries, Advanced Manufacturing, SCALE.AI, and Ocean. These clusters accept members from the government, industry, and non-profit sectors while providing opportunities for members to collaborate on projects and address real-world problems. The superclusters aim to bridge science and technology to attract investment and create ecosystems.[36]

The Superclusters Initiative aims to accelerate the growth and development of large-scale business-led innovation superclusters, translating the strengths of Africa's innovation ecosystems into new commercial and global opportunities for growth and competitiveness. By creating innovation ecosystems, superclusters support every pillar of the Innovation and Skills Plan — advancing skills development, fundamental and applied research, commercialisation, investment, growth, and exporting. On the other hand, the Superclusters' challenges include building lasting advantages from high-density networks and clusters.

The achievements include the five superclusters that have been selected to represent more than 450 businesses, 60 post-secondary institutions, and 180 other participants. This will match the targeted investments, dollar for dollar, of up to US$950 million over five years. These superclusters are representing a new way of doing business — one where the African Governments can provide targeted and direct investments through a selection process to build long-term advantage, develop global brand recognition, draw investment, attract talent, and create new opportunities for Africans. Selecting the superclusters will be a competitive two-phase application process focused on how applicants could deliver the strongest value and best position in Africa for global leadership. US$950M/5 years.

The five superclusters chosen to receive funding will encompass more than 450 businesses, 60 post-secondary institutions, and 180 other participants. The Ocean Supercluster will harness emerging technologies to strengthen Africa's ocean industries — industries such as marine renewable energy, fisheries, aquaculture, oil and gas, defence, shipbuilding, and transportation.

a) Contribution: Up to US$153 million.
b) GDP impact over 10 years: US$1.4 billion.
c) Jobs created over 10 years: Expected to create 50,000 middle-class jobs and grow Africa's economy by US$10 billion over the next 10 years.

The Advanced Manufacturing Supercluster will build up next generation manufacturing capabilities, incorporating technologies such as advanced robotics and 3D printing. By focusing on training and technology adoption, this supercluster will help make the words "Made in Africa" synonymous with "innovative" and "value-added". This will result in the following investments and the economy:

a) Contribution up to US$230 million.

b) GDP impact over 10 years: US$1.35 billion.

c) Jobs created over 10 years.

The Protein Industries Supercluster will leverage modern processing technologies and plant genetics to raise the value of important African crops that are sought after in fast-growing international markets for plant-based meat substitutes and new food products. This supercluster will establish Africa as a top supplier of plant proteins, building on its international image as a leader in agricultural production and, ultimately, feeding the world.

a) Contribution up to US$153 million.
b) GDP impact over 10 years: US$450 million.
c) Jobs created over 10 years: 4,500.

[35] OECD. 2018g. OECD.Stat. Available at: https://stats.oecd.org/
[36] CRTC. 2017. Communications Monitoring Report 2017. Available at: https://crtc.gc.ca/eng/publications/reports/policymonitoring/2017/index.htm

4.6 SKILLS GAP ASSESSMENT FOR AI IN AFRICA

It is important to situate the vision for human capacity development by discussing not only where it is Africa wants to be, in terms of skills requirements, but also by taking stock of where Africa is currently situated now. It will be crucial to then examine the differences between the two to address the current human capital programmes strategically and effectively in Africa. One study facilitated by IFC and included in the report 'Digital Skills in Sub-Saharan Africa: Spotlight on Ghana' found that the top ten skills required for the future workforce include critical and analytical thinking, communication, problem-solving, leadership, collaboration, computer literacy, application of technology, creativity, decision making & reasoning, and teamwork.[37] Many of these skills are not necessarily about what people know or have been trained to do but rather their ability to learn, to adapt and to continually evolve along with new ways of working where we are seeing rapid evolution.

There are several considerations that Africa should examine and deliberate on the current state of human capital development. One of these is the fact that the acquisition of foundational skills is poor. At the primary school level, learners' performance is quite poor. This is related to a lack of availability of resources, such as classrooms and enough teachers. Particularly, as schools globally move towards more technology-based methods of learning, resources such as enough books, let alone the technological inputs of resources required for digital learning.[38] There is also the matter of language of learning. Some African countries such as Kenya have education policies that acknowledge the importance of learning in one's primary language or mother tongue in the formative years of education. However, the implementation of these policies is low, particularly due to the lack of availability of resources.[39]

When it comes to higher education, it is also of note that often, employers complain about the un-employability of graduates and trainees from educational institutions. Many existing curricula are outdated, a situation which is compounded by long and arduous processes for updating these curricula. Employers express that the unavailability of talent poses a constant challenge to the growth of their businesses. In contrast, what the market requires are basic to intermediate digital skills for people to be considered ready for the job market or for them to be trainable for the job market. This lack of digital skills poses a major barrier to productivity and job market readiness for many.[40]

There are several ways to get the requisite digital skills, particularly for individuals who are not currently enrolled in digital institutions. The first is training as a business product offered to a business. The second is training as a business product offered to a government. Government is a major employer of populations across the continent and could be a strategic partner in this work. In addition, the digitization of social and government services would go a long way in improving the quality of life of the people through better service delivery from the government.

The third and final way that these digital skills could be imparted is by businesses targeting consumers. This is however a much harder business model since individual consumers may not be able to pay for their upskilling or may not see enough value in such a proposition to pay for it. Remarkably, the first and second propositions, for business-to-business and business-to-government strategies, are therefore most likely to have success in an African context.

4.7 TYPES OF STAKEHOLDERS AND TARGET GROUPS

When conceiving to articulate the skill gap on the continent, the task at hand is quite wide, particularly when you consider that the population is composed of people at different places in their educational training or careers. The spectrum of individuals and the skills they have or can receive either from the

[37] International Finance Corporation and L.E.K. Consulting. "Digital Skills in Sub-Saharan Africa: Spotlight on Ghana" (2019).
[38] OECD. 2017e. Science, Technology, and Industry Scoreboard 2017. Paris: OECD Publishing. Available at: https://read.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2017_9789264268821-en#page8
[39] https://kenya.ai/
[40] https://radasektorowa-komunikacja.pl/wp-content/uploads/2020/04/Future-of-Work-Report_7-Drivers_Talent-Alpha_-2019.pdf

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educational institution they are based at or at the business organisation they are affiliated with is wide and can be split in several different ways.

The various platforms available for capacity building are contextualized based on the image derived from the Report of the Presidential Commission on the Fourth Industrial Revolution, which was released by the Government of South Africa in October 2020. [41] Figure 3 provides a visual representation of South Africa's Human Capacity Development ecosystem, offering a comprehensive overview of the different stages of training accessible. It serves as a reference point and is expected to be highly applicable to other regions across the continent. The platforms and stakeholders identified in the image include early childhood development education, primary education, secondary education, technical and vocational education training, university education, industry training initiatives for the employed, support for the unemployed, targeted programmes for the older population, and provisions for small and medium enterprises.

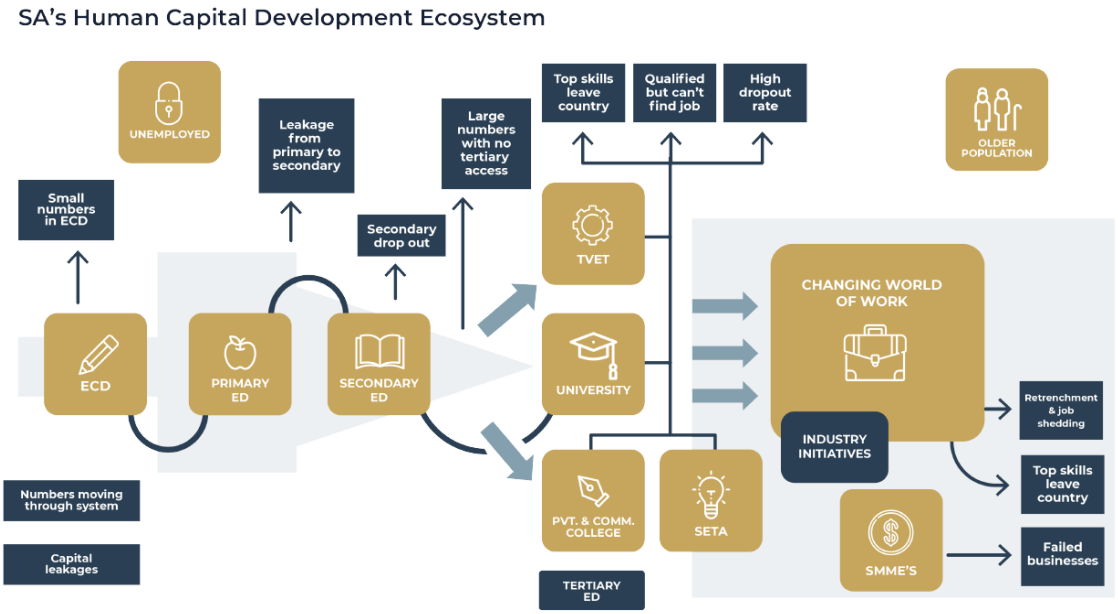

Figure 3. South Africa's Human Capital Development Ecosystem[42]

Below are the target groups and brief details on what opportunities exist for training:

4.7.1 EARLY CHILDHOOD, PRIMARY AND SECONDARY EDUCATION

Where children and AI are concerned, the primary challenge Africa is currently facing is similar to that faced by the rest of the world; How do we protect them from the potential harms that AI technologies pose while improving their lives and their educational outcomes? Children are impressionable and the most at risk due to their youth and innocence. They are also the target of long-term AI capacity-building efforts. Therefore, Africa cannot risk leaving them out of any strategies if African countries hope to build a strong foundation for impact.[43]

To succeed at protecting them while also equipping them with relevant skills, a legal and policy framework is necessary. Many vendors developing AI-driven educational products for children are private

[41] https://www.gov.za/documents/report-presidential-commission-4th-industrial-revolution-23-oct-2020-0000
[42] https://www.gov.za/documents/report-presidential-commission-4th-industrial-revolution-23-oct-2020-0000.
[43] https://www.intelligentcio.com/africa/2019/11/18/bridging-the-technology-skills-gap-in-africa/#

sector partners, therefore ensuring that there is a legal framework available would go a long way in standardising what safeguards should be put in place. It would subsequently be important to create awareness around what potential harms exist, what benefits are expected and how exactly AI technologies are used in the education products consumed by children.[44]

When African countries peak at making it clear how exactly AI technologies are used in education products consumed by children, this education needs to primarily be targeted at children, and this is perhaps the most difficult market to educate, and therefore the best one to centre in this exercise.[45] Centring the education and experience of children is key, particularly as oftentimes, these technologies are conceived for older populations but still find their way into use by children. Children, therefore, are rarely the target of the development of AI technology but are impacted by them. Centring their experience may therefore be viewed as centring marginalized voices, we rarely think to ask children what they want or need and instead pass on this role to their parents or guardians. Children are however increasingly becoming vocal about wanting to be involved in decision-making that concerns them.[46]

It is important to build on the work of organisations such as UNICEF, which have created various frameworks on the theme of children's rights and protections. However, African countries should not get entirely consumed by the task of protecting children that we forget to empower them through using these technologies. AI should be exciting and educational for children, and we should enable them to self-govern their experiences in interacting with technology to a great extent.[47]

4.7.2 ADULT EDUCATION

Entrepreneurs: African entrepreneurs are an important target group as they are building solutions for local problems in their various contexts. It is therefore worth exploring avenues via which they can become knowledgeable about AI technologies and any opportunities that may exist for them to incorporate these into their businesses. Various avenues can be explored to target or reach entrepreneurs, particularly to upskill them. These include the use of incubators, accelerators and through mentorship opportunities.

A case study of the Africa AI accelerator[4] has demonstrated that an accelerator programme can meaningfully contribute to the capacity building of entrepreneurs and specifically equip them with technical AI skills. In a previous edition of the accelerator, companies building in fintech, agriculture and healthcare featured in the first cohort of this accelerator. However, the trends indicate that venues such as these tend to attract entrepreneurs from high socioeconomic backgrounds who are therefore also serving higher-income markets. It is therefore necessary to think further about how to include low-income earners as moving forward with this gap would repeat trends seen with other technologies where those without easy access are increasingly not catered for.

African AI Researchers: Technical competence can sometimes be viewed as the only prerequisite for AI researchers and practitioners. However, it is important to situate all work that will impact people and society with the potential harm that these technologies may result in. When considering technical capacity building, it is important to also consider topics such as AI governance and ethics as key components of the training. Those working in AI need to be equipped to examine the effects of the solutions they deploy into society.

[44] Balsillie, James Laurence. 2018. E-mail statement cited by James McLeod, Financial Post, April 26, 2018, Ottawa to unveil IP strategy aimed at innovators, small businesses. Available at: https://business.financialpost.com/technology/ottawa-to-unveil-ip-strategy-aimed-at-innovators-small-businesses

[45] Calligaris, S., Chiara Criscuolo and Luca Marcolin. 2018. Mark-ups in the digital era. OECD Science, Technology, and Industry Working Papers, 2018/10. Paris, OECD Publishing. Available at: https://www.oecd-ilibrary.org/deliver/4efe2d25-en.pdf?itemId=%2Fcontent%2Fpaper%2F4efe2d25-en&mimeType=pdf

[46] http://www.scielo.org.za/pdf/ajic/v26/02.pdf

[47] ICTC. 2018. The Digital Talent Dividend: Shifting Gears in a Changing Economy. The Information and Communications Technology Council. Available at: https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC-Report_The-Digital-Talent-Dividend-FINAL-ENGLISH-1.30.18.pdf.

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One case study of the Harambee Youth Accelerator programme which demonstrates the use of AI as an input to development agendas (using AI to improve general labour force participation or educational outcomes) explored whether there may be any human rights implications, whether the programme was exacerbating social inequalities and finally whether the local context, in this case the South African ecosystem, was equipped to support successful outcomes where the implementation of AI programmes is concerned.

The case study explored a variety of human rights issues such as algorithmic transparency, fairness, and bias, and found that these are not addressed by the accelerator programme. There were several risks identified. Given the history of Apartheid in South Africa, spatial planning continues to place marginalized people in areas that are remote with poor access to educational, economic, and social opportunities, thus compounding the marginalization they have been subjected to. While this only explores what opportunities there are for bias in a South African context, it is important to note that with each local context across the African continent, there is a need to continuously interrogate and explore what opportunities for bias there exist, particularly those that could be built on historical infrastructure that is based on prejudice. AI algorithms have the potential to reinforce existing social inequalities using proxies such as geographical locations, educational background, and ethnic identity, among others, therefore it is important to be critical of the decisions that these systems make.

Informal Sector: Adult education can play a vital role in upskilling the unemployed, underemployed, and underutilised Africans to take advantage of AI in Africa. Many of these individuals are currently working as part of the informal sector. Unfortunately, the low quality of education in Africa leads to a large potential workforce that is not easily trainable due to poor outcomes within foundational skills such as reading, writing, numeracy and problem-solving.[48] It is necessary to develop a curriculum and learning tools that are tailored to their needs. This would involve local language training and education, supported by technical tooling to reduce the bottleneck that a lack of literacy training imposes on the ability to train the workforce and get it to productivity. Collaboration with the industry is essential for designing a curriculum that is relevant and practical. Working with AI experts, organisations working in agriculture and vocational industries can develop educational tools in local languages to equip these individuals with the skills to be productive. Having the organisations as collaborators ensures we can provide access to a ready job market to absorb the labour once it is trained.

AI-powered learning tools can be used to enhance the learning experience. For example, gamification and simulations can be used to make the learning process more engaging and interactive. The government can provide financial support to fund the program and offer incentives for companies to participate in the program and hire graduates from it. African countries can form public-private partnerships to provide funding and support for these AI education initiatives. These partnerships should be focused on providing funding for AI research, development, and implementation, specifically to serve the needs of the organisations that are best placed to absorb this capacity. Continuous evaluation of the program's effectiveness is necessary to ensure that the desired outcomes are achieved. This can be done through surveys, feedback sessions, and tracking the employment outcomes of program graduates.

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4.7.3 PRIORITY GROUPS

While there are opportunities for capacity building at all points of the human resource development pipeline, this sub-section highlighted and discussed the priority groups whose upskilling is critical to enable significant gains through leveraging AI in the short and long term.[49] This sub-section also

[48] https://reliefweb.int/report/world/world-development-report-2018-learning-realize-education-s-promise
[49] ISED. 2018a. Summary of the Survey on Financing and Growth of Small and Medium Enterprises, 2017. Available at: http://www.ic.gc.ca/eic/site/061.nsf/vwapj/SFGSME_Summary-EFCPME_Sommaire_2017_eng-V2.pdf/US$file/SFGSME_Summary-EFCPME_Sommaire_2017_eng-V2.pdf

highlighted the short-term as it is important to begin exploiting the current low-hanging opportunities to strengthen the long-term foundations. This will enable Africa to become the global leader in the AI field.[50]

In the short term, it is important to support inventors and entrepreneurs building digital technologies. These stakeholders, focused on solving local context problems, are in a unique position to directly impact the lives of everyday people. Therefore, inventors and entrepreneurs, in their activities, should focus on the scaling of digital technologies that could boost the productivity of low-skilled workers and boost healthcare service delivery to improve the health prospects of the masses.[51]

As businesses continue to implement AI tools to boost efficiency and productivity, employees will need to be trained in the use of these new tools, in addition to understanding concepts of data governance.[52] These businesses will then also need to invest in technical talent in the form of data engineers and data scientists who are expected to do most of the heavy lifting when it comes to the development, deployment, and maintenance of AI tools within organisations. Then, within businesses, there need to be individuals and teams with a deep contextual understanding of the business space as well as a deep understanding of the capabilities of AI tools and technologies. This will help African businesses to identify gaps and opportunities for the use of AI tools and collaborate on building these new AI applications.[53]

The ideal would be that while businesses begin with making use of commercial AI tools, they can progressively build toward custom making some of their own, with the incorporation of proprietary knowledge[54]. In addition to these, industry and government surveys should be run periodically to ensure there is regular identification of skills, qualifications, and requirements for various industries[55]. Additionally, another priority area, this time for long-term gains, is increased investment in early childhood education. This group presents us with the opportunity to impart foundational knowledge and skills to children to get them AI literate and potentially equip them with the skills to build AI solutions.

Early Childhood Education: In Africa, a learner's inability to adequately communicate in English, French or Portuguese (colonial languages that have become official languages) contributes to their poor performance in schools.[56] In Tanzania, a country with a well-regarded education system, despite Kiswahili having been adopted as the language of instruction in primary schools in 1967, only 6% of learners who entered primary school in 1995 went on to join secondary school.[57] This demonstrates that calling for multilingual education legislation is not enough. State functions in the developing world cannot be compared with similar systems in industrialized societies. In South Africa, outcomes of a study that implemented multilingual mobile learning applications suggest that particularly in lower-income rural areas where there is a common shortage of teachers in key learning areas such as mathematics and science; 1) there is a need for supplementary learning material, 2) which learners would not need to spend money to obtain, 3) particularly material in local languages.[58]

To tackle these challenges, we propose the use of AI language tools targeting early childhood education as a means of aiding educational policies across Africa that call for mother-tongue learning at this level. Machine translation tools can aid in making more learning material available in local languages, particularly children's stories which can aid in literacy learning. Speech Recognition and Speech Synthesis tools can be employed in mobile learning applications to enable students to get personalised

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[50] ISED. 2016. Key Small Business Statistics, June 2016. Available at: http://www.ic.gc.ca/eic/site/061.nsf/vwapj/KSBS-PSRPE_June-Juin_2016_eng-V2.pdf/US$file/KSBS-PSRPE_June-Juin_2016_eng-V2.pdf
[51] IDC. 2017. Data Age 2025: The Evolution of Data to Life-Critical — Don't Focus on Big Data; Focus on the Data That's Big. IDC White Paper by David Reinsel, John Gantz and John Ryding. Available at: https://www.seagate.com/files/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf
[52] Impact Centre. 2017. A Failure to Scale: Are We Creating Financially Unattractive Companies? Available at: https://www.impactcentre.ca/wp-content/uploads/2015/05/Velocity-Impact-Brief.pdf
[53] IHS Economics. 2017. 5G wireless technology is projected to enable US$12.3 trillion of global economic output. Available at: https://www.qualcomm.com/media/documents/files/ihs-5g-economic-impact-study.pdf
[54] https://www.pwc.ie/issues/artificial-intelligence-six-priorities.html
[55] https://unevoc.unesco.org/pub/understanding_the_impact_of_ai_on_skills_development.pdf
[56] Probyn, M. (2017). Languages and Learning in South African Classrooms: Finding Common Ground with North/South Concerns for Linguistic Access, Equity, and Social Justice in Education. In: Trifonas, P., Aravossitas, T. (eds) Handbook of Research and Practice in heritage Language Education. Springer International Handbooks of Education. Springer, Cham. https://doi.org/10.1007/978-3-319-38893-9_28-1.
[57] https://files.eric.ed.gov/fulltext/EJ1272578.pdf.
[58] https://core.ac.uk/download/pdf/47261802.pdf.

learning experiences through voice interactions with a tutoring system. This would ease the pressure on the availability of teachers, especially with the expectation that they should be able to teach in the various local languages. Making these technology tools available in low resource settings and at low cost will require innovation and should be built upon the infrastructure to support remote learning as discussed in section 5.9.1.

Persons with disabilities (PWD): It is observed that individuals belonging to the "unemployed, under-employed, and under-utilised" groups, particularly persons with disabilities, are often excluded from existing educational and training systems. According to a 2019 report by GSMA, the widespread adoption of mobile phone technologies is offering an opportunity for the implementation of digital assistive technologies in low- and middle-income countries. This signifies the potential of mobile technology in addressing the needs and empowering individuals with disabilities in accessing education and training opportunities.[59] AI tools known as assistive technologies, such as text-to-speech systems which can produce audios of written text or sign language to text and sign language to speech interpreters, and vice versa, when employed in training settings can aid towards enabling persons with disabilities to receive educational training and should also be used within workplace settings to accommodate persons with disabilities. Government budgets set aside for persons with disabilities should in part be invested in the development of these tools to create a supportive and inclusive environment for PWD to thrive and be productive. Government should also set aside funds which can be accessed by PWDs who would like to start businesses.

In these efforts, it is important to ensure that the existing legal framework in various countries supports the use of these tools. In 2022, Blind SA, an organisation, challenged the Minister of Trade, Industry & Competition and others in court, asserting that the Copyright Act was unconstitutional as it impeded the reproduction of educational materials in a format accessible to individuals with visual disabilities, specifically speech or audio format.[60] It can be inferred that the outcome of the court case would have significant implications for the rights of visually impaired individuals in accessing educational resources. The case highlighted the importance of ensuring equal access to educational materials for individuals with disabilities and the need to strike a balance between copyright protection and accommodating the diverse needs of disabled communities. It also underscores the significance of addressing legal and regulatory frameworks to promote inclusivity and remove barriers to education for the marginalized.[61]

Women: Women tend to be underrepresented in STEM fields, with only 18% to 31% of science researchers in Sub-Saharan Africa being women. This is in comparison to 49% in Southeast Europe and the Caribbean; 44% in Central Asia and Latin America; and 37% in the Arab States.[62] Women account for slightly over half of the human population on Earth and would like for the representation of participation in STEM to be reflective of this.

The African Union (AU) has taken significant steps to enhance women's participation and empowerment across the continent. In 2015, the AU declared it the Year of Women's Empowerment and Development as part of its commitment to the African Union's Agenda 2063. [63] This declaration aimed to raise awareness and prioritise women's empowerment in various spheres of life. Furthermore, the AU has implemented frameworks such as the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024), which emphasizes the importance of providing women with equal opportunities in pursuing careers in science, technology, engineering, and mathematics (STEM) fields. These efforts have had positive outcomes and impacts, including increased awareness of gender equality issues, improved access to education and resources for women, greater representation of women in STEM disciplines, and enhanced prospects for women's empowerment and development in Africa.[64]

[59] https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/07/GSMA_Digital-Exclusion-of-Women-with-Disabilities_44pp_ACCESSIBLE.pdf.
[60] https://www.concourt.org.za/index.php/judgement/485-blind-sa-v-minister-of-trade-industry-and-competition-and-others-cct320-21.
[61] https://powersingh.africa/2022/09/21/blind-sa-v-minister-of-trade-industry-and-competition/.
[62] https://blogs.worldbank.org/africacan/lets-accelerate-women-stem-agenda-today-tomorrow-will-be-too-late.
[63] https://au.int/sites/default/files/documents/31358-doc-au_echo_january_2015.pdf.
[64] https://furtherafrica.com/2023/04/28/bridging-the-stem-gender-divide-to-spur-africas-sustainable-future/.

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Organisations such as the Women in Machine Learning and Data Science (WiMLDS) whose mission is to support women and gender minorities who are practising in these fields or interested in venturing into them also play a key role. WiMLDS currently supports local chapters in 11 African countries including Kenya, Ghana, Nigeria, Cameroon, and Rwanda.[65] These chapters regularly hold events where women can share their work as well as learn about and explore career opportunities in the field. These efforts contribute towards improving women's participation, and economic security and preventing biases in the downstream products and services generated in these fields.

4.8 THE FUTURE OF WORK FOR AFRICA

4.8.1 MULTI-SECTORAL IMPACTS OF AI ON WORK IN AFRICA

AI will have a great impact on the world of work, both in Africa and in the rest of the world. In this section, we attempt to break down the impacts of AI in various sectors and the effect on labour. In some cases, it is positive with new jobs being created, in others it is negative with job losses expected to be experienced en mass and in other sectors, we find that the introduction of AI tools and technologies provides an opportunity for more labour to be utilised in underserved sectors.[66] In thinking about employment in Africa, we organise our sentiments in several broad categories; these are agriculture, services (such as healthcare, education, finance, and banking) and industry (including telecommunications, transport and logistics, water and waste, and mining and energy).[67]

4.8.1.1 AGRICULTURE

The International Labour Organisation estimates that by 2023, half of all employment within the African continent will be based in agriculture.[68] Smallholder agriculture which is dominant on the continent is a gruelling task and the leading employer in irrigation.[69] There is strong potential for traditional tools used by farmers from older generations to be replaced by AI-powered precision agricultural decisions and technologies for the use of fertilizers, distributing pesticides, monitoring crops, weather forecasting, irrigation and market information to attract the youth to enter the industry.[70] This can result in increased crop yields and reduced costs, which are important for farmers who have limited resources. The use of robotics in agriculture also has the potential to reduce input use and increase profitability.[71] There is a need to create awareness through training opportunities among the youth and future farmers about the huge potential of AI to make agriculture smart and attractive to create employment and wealth for practitioners along the value chain.[72] Additionally, there is a need for governments to continue advancing AI innovation within the agriculture sector by encouraging and financially supporting agriculture start-up companies and research centres.[73]

Across the continent, agriculture start-up companies are leveraging AI in a variety of ways. In South Africa, Aerobotics provides solutions including AI pest and disease detection and uses drone imagery to help farmers achieve precision in optimising yields[74]. In Cameroon, Agrix Tech aims to help subsistence farmers

[65] https://www.gpai.ai/projects/data-governance/advancing-data-justice-research-and-practice-annotated-bibliography-and-table-of-organisations.pdf.
[66] https://www.delltechnologies.com/content/dam/delltechnologies/assets/perspectives/2030/pdf/Realizing-2030-A-Divided-Vision-of-the-Future-Summary.pdf
[67] https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world/.
[68] International Labor Organization. "Africa's Employment Landscape." (2019) https://ilostat.ilo.org/africas-changing-employment-landscape/
[69] OECD. 2018e. OECD Economic Outlook 2018. Paris: OECD Publishing. Available at: http://www.oecd.org/eco/outlook/
[70] May, Daniel, et al. "Preventing young farmers from leaving the farm: Investigating the effectiveness of the young farmer payment using a behavioural approach." *Land use policy* 82 (2019): 317-327.
[71] Raj, E. Fantin Irudaya, M. Appadurai, and K. Athiappan. "Precision farming in modern agriculture." Smart Agriculture Automation Using Advanced Technologies: Data Analytics and Machine Learning, Cloud Architecture, Automation and IoT. Singapore: Springer Singapore, 2022. 61-87.
[72] Liu, Ye, et al. "From Industry 4.0 to Agriculture 4.0: Current status, enabling technologies, and research challenges." IEEE Transactions on Industrial Informatics 17.6 (2020): 4322-4334.
[73] Weller, Chris. 2017. These are the 25 most high-tech cities in the world. World Economic Forum. Available at: http://amp.weforum.org/agenda/2017/08/these-are-the-25-most-high-tech-cities-in-the-world
[74] https://www.aerobotics.com/

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transition to commercial farming with an AI app incorporating computer vision and voice-recognition technologies to identify crop diseases and discover solutions to address them.[75] Agripoa, a startup based in Tanzania and Mauritius has created farm management software leveraging AI to connect farmers to suppliers, provide a marketplace to sell products and track business expenses.[76] Given the large share of agriculture employment within the African continent the continued growth of start-up companies in this space will only stand to unlock more employment opportunities for youth.[77]

4.8.1.2 HEALTHCARE

Throughout the world, the healthcare sector is shown to be critically understaffed. However, despite having the highest disease burden, the African continent suffers from an extreme shortage of healthcare workers. A 2022 study released by the World Health Organisation (WHO) surveying 47 African countries shows that the continent has a ratio of 1.55 healthcare workers per 1000 people, a ratio significantly below the 4.45 healthcare workers per 1000 people threshold set by the WHO.[78] A significant finding of the study also showed that the ratio of healthcare workers per 1000 people has a wide distribution within the continent, with Niger having 0.31 healthcare workers per 1000 people to Seychelles having 14.5 healthcare workers per 1000 people. This study shows that as of 2018, 3.6 million healthcare workers are in the 47 countries surveyed.[79]

These workers are split into the following professions: nurses and midwives (37%), community health workers (14%), administrative and support staff (12%), laboratory staff (10%), medical doctors (9%), and other healthcare workers (14%). With factors including low production of healthcare workers, weak healthcare governance, poor worker retention, and the ongoing COVID-19 pandemic, the shortage of healthcare workers within the African continent is projected to reach 6.1 million by 2030.[80] Given the estimated number of 4001 healthcare training centres within Africa and the production rate of 148,357 healthcare workers, as measured by Okoroafor et. al[81], African countries should make strategic investments to strengthen training to increase the number and quality of healthcare workers while improving the efficiency of healthcare systems. Overall, as African governments work to improve healthcare, introducing AI into these processes can help accelerate this transformation.[82]

Given the existing state of healthcare systems within the African continent, there exist many opportunities for AI to supplement existing worker capacity[83] and provide more career opportunities to bolster the healthcare labour force. A 2020 report released by the Broadband Commission, Novartis Foundation and Microsoft proposes that AI could be adopted within healthcare systems in Africa much faster than in developed countries since there are fewer systems (databases, electronic medical records, disease registries, etc.) in place to hinder the adoption due to issues such as interoperability.[84] However, to support the adoption of AI within healthcare and other systems, there is a need for stronger data protection policies and AI regulation within African governments. There is also a need for African governments to provide support to startup ecosystems to promote innovation within the AI for the healthcare sector.

Currently, there exists a plethora of start-up companies working to integrate AI to solve a variety of problems ranging from radiology to remote healthcare monitoring. In Ghana, minohealth AI Laboratories has leveraged AI to automatically diagnose 14 chest conditions including pneumonia, fibrosis, and hernia along

[75] http://www.agrixtech.com/
[76] https://agripoa.com/en/
[77] Kenny, Charles. 2017 Really, Global Poverty Is Falling. Honest. Centre for Global Development. Available at: https://www.cgdev.org/blog/really-global-poverty-falling-honest
[78] Ahmat, Adam, et al. "The health workforce status in the WHO African Region: findings of a cross-sectional study." *BMJ Global Health* 7. Suppl 1 (2022): e008317.
[79] https://link.springer.com/chapter/10.1007/978-981-13-9996-1_4
[80] Okoroafor, Sunny C., et al. "An overview of health workforce education and accreditation in Africa: implications for scaling-up capacity and quality." Human Resources for Health 20.1 (2022): 1-7.
[81] Okoroafor, S.C., Ahmat, A., Asamani, J.A. et al. An overview of health workforce education and accreditation in Africa: implications for scaling-up capacity and quality. Hum Resour Health 20, 37 (2022). https://doi.org/10.1186/s12960-022-00735-.
[82] https://observatoire-ia.ulaval.ca/app/uploads/2019/08/artificial-intelligence-development-an-introduction.pdf
[83] Owoyemi, Ayomide, et al. "Artificial intelligence for healthcare in Africa." *Frontiers in Digital Health* 2 (2020): 6.
[84] Reimagining Global Health through Artificial Intelligence: A Roadmap to AI Maturity. 2020. https://www.broadbandcommission.org/publication/reimagining-global-health-through-artificial-intelligence/

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with diagnosing breast cancer, malaria, tuberculosis, and COVID-19.[85] In South Africa, the startup hearX Group has developed a digital video otoscope to capture high-quality images and videos to aid in the diagnosis of various ear diseases.[86] In Zambia, Dawa Health serves pregnant women and new mothers through a web platform integrated with AI to facilitate remote healthcare monitoring of symptoms often associated with pregnancy-related complications.[87] These start-up companies are only a few examples of the emerging AI healthcare ecosystem within Africa, however, to best improve the existing state of healthcare systems, African countries should leverage startup innovation in tandem with building traditional healthcare capacity by investing in medical training, health facilities, and healthcare data infrastructure.

4.8.1.3 FINANCE AND BANKING

In the financial sector, data-driven decision-making is crucial when vetting creditworthiness loan seekers. AI offers more efficient credit scoring capabilities that use complex decision rules than would be the case with traditional credit scoring systems. Thus, the decision task of assessment of the potential borrower is executed in a faster and more accurate way compared to prior AI-based solutions. The next-generation banking sector applications that implement image processing capabilities to help with customer mortgage applications, location-based targeted campaigns and/or conversational AI are game-changing innovations. Banks can meet personalized digital experiences to satisfy customer demands that always change. For instance, Ecobank, United Bank for Africa Plc (UBA), Co-operative Bank of Kenya, Nedbank, and Attijariwafa are pan-African banks that are found in many African countries. They have not only increased smartphone penetration but changed mobile banking solutions to provide enhanced digital financial services to boost financial inclusion.

Africa has become the innovator of numerous mobile money payment systems that are meant to bridge the lacuna between urban and remote rural areas as well as aid monetary transactions across countries. For instance, Kenya developed M-Pesa which has been adopted across over 10 countries on the continent, Botswana delivered on Orange Money to enable mobile money transfer anywhere across the country, South Africa has Mukuru and MTN money, with wide digital footprints in many countries and Zimbabwe has EcoCash that increases digital monetary liquidity in the country. All these platforms have brought convenience and are operating in more than one African country. This democratization of financial services has made the region the global leader in mobile money innovation, adoption, and usage. This digital transformation, if infused with innovative technologies as offered by IBM cloud and AI platforms, the African continent is poised for greater employment opportunities across the workflow pipelines, from data collection to data analytics and data visualization. AI solutions have improved the gleaning of insights on customer data, speed query resolutions and time-to-market on new services across channels.

4.8.1.4 FINANCIAL SERVICES

AI and machine learning in finance encompasses everything from chatbot assistants to fraud detection and task automation.[88] Financial institutions that use AI accelerate how services reach out to their customers. Customers can now have 24/7 online services, accounts, and financial advice via chatbots, they streamline repetitive tasks and thus improve customer experiences. At a personal level, clients can be advised a priori about the price hikes in subscription services and help fraud detection to prevent cyberattacks. Customers want assurance of the security of their investments and AI provides a platform that lessens the likelihood of financial crimes and anomalous activities. This saves time spent by analysts, accountants, credit controllers, investors, and treasurers in carrying out spot audits. Chatbots are becoming popular in the African banking sector, with many banks using them to provide customer support and personalized assistance to clients. For

[85] https://www.minohealth.ai
[86] https://www.hearxgroup.com/hearscope
[87] https://dawa-health.com/
[88] Alex, Dhanya, and Jomy Lawrence. "Redefining Banking with Artificial Intelligence Strategy for Future." *LIBA's Journal of Management*: 44.

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example, Standard Bank, one of Africa's largest banks, uses chatbots to answer customer queries, provide personalized recommendations, and even help customers open new accounts.

However, there are urgent challenges that may need to be considered: AI credit scoring would bring services that traditionally would not have been available to other people, but the challenge is how to develop responsible AI algorithms that are explainable and sustainable. There are also concerns about developing comprehensive AI ethics to bolster AI security, privacy, and data protection in Africa.

There is the challenge of the nature of the AI curriculum to develop. This is because the proposed Artificial Intelligence curriculum should prepare the next generations to acquire the competencies suitable for the future. Therefore, APET proposes an AI curriculum to cultivate students' AI literacy to answer the question of 'why and what to teach' about AI.[89] The aspired AI curriculum focuses on achieving AI literacy based on three competencies: AI Knowledge, AI Skill, and AI Attitude and should not only be limited to the elementary level of learning but should be cascaded to higher and tertiary education so that institutions release graduates with the right knowledge, competent industry-focussed skills, and competence to ensure their employability in the economy.[90]

There is the problem of loss of employment as AI and robotics systems continue to take centre stage in the automation of human-driven tasks. For example, according to a prediction, in 2025, robots will be hired for around 3.5 million jobs and there will be no good office jobs for people.[91] According to the same report, in 2025, there will be no need for nursing carers for older people because robots will perform caring duties. As a result, Japan will be able to save a budget of 2.1 trillion yen (US$21 billion) that can be spent on insurance payments for elders. In 2030, Japan will be able to save 16%, depending on the number of jobs occupied by robots.

There is a challenge in training AI systems to understand natural languages in a manner that these systems can effectively use language for a variety of tasks. For instance, a recent survey by World Economic Forum (WEF) established that by 2025, there would be more unemployment as more professions continue to adopt technologies in their workflows. The report revealed that in the next 5 years, robots will take over 5.1 million office jobs. Another survey carried out by young workers in Western countries showed that these workers were not able to perform their jobs adequately only relying on their education as their qualifications do not prepare them to attain the necessary skills. According to 80% of the respondents, it is highly needed to learn advanced technical skills, other than the school syllabus, to keep pace with the advancements in robotics.[92]

Whilst some jobs may be partially augmented or replaced by AI, re-examining and rethinking some processes to make them more efficient and efficiently provide new services and achieve new levels of productivity and worker satisfaction.[93] Additionally, lifelong learning and skill development. The technology industry is always changing and so should be the uptake and sustenance of ever-lasting skills. Certifications and aptitude skills are necessary but should always be current and to the expectation of the AI industry. Furthermore, there should be a reconfiguration of work arrangements and Innovation. Numerous worldwide organisations, as of now, effectively utilise crowdsourcing platforms to source new thoughts, take care of issues, and plan complex frameworks.[94]

4.8.1.5 TELECOMMUNICATIONS

The telecommunications sector relies heavily on a physical infrastructure, through which information traffic flows. This includes telephone lines, satellites, microwaves, and mobile technology such as 4G and 5G

[89] Kim, Seonghun, et al. "Why and what to teach: AI curriculum for elementary school." *proceedings of the AAAI Conference on Artificial Intelligence*. Vol. 35. No. 17. 2021.
[90] Stynes, Paul, and Pramod Pathak. "Curriculum Development Framework: A Tool for Innovative Programme Development." EDULEARN20 Proceedings (2020): 3455-3465.
[91] Shaukat, K., et al. "The impact of artificial intelligence and robotics on the future employment opportunities." *Trends Comput. Sci. Inf. Technol* 5 (2020): 50-54.
[92] Skilton M, Hovsepian F (2017) The 4th industrial revolution: Responding to the impact of artifi cial intelligence on business: Springer. https://link.springer.com/book/10.1007/978-3-319-62479-2
[93] Acemoglu D, Restrepo P (2018) Artificial intelligence, automation, and work. National Bureau of Economic Research. https://www.nber.org/papers/w24196
[94] Sagara H, Das K (2020) Technological Disruptions and the Indian IT Industry: Employment Concerns and Beyond. In Digitalisation and Development ed: Springer 119-143.

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networks. By the end of 2021, there were 515 million people subscribed to mobile services in Sub-Saharan Africa.[95] We therefore expect that due to the tight coupling between a physical infrastructure and the provision of services, predictive maintenance of the infrastructure, and the ability to anticipate when failures will happen and to address them, based on historical data of the networks would be beneficial to telcos. Similarly, being able to monitor the network when in use and detect any anomalies in the traffic can improve business efficiency. If a bottleneck can be detected and traffic rerouted and any interruptions in service handled fairly quickly, this improves customer satisfaction. Then beyond network anomaly detection, the network can further be optimised to, for example, better handle traffic flow when the volume and velocity are high to prevent downtime.[96] These opportunities in network monitoring and optimisation present employment opportunities for highly skilled labour that can collect large amounts of real-time data, process it to derive meaning and make decisions.

4.8.1.6 TRANSPORT AND LOGISTICS

In Africa, transport services can be broken down into the following medium; road/highways (78%), railways (9%), air (8%) and port/water (2%). Additionally, 3% of transport is then classified as involving more than one medium.[97] AI is already being used within transport and logistics in various ways. For instance, Zipline is an American organisation that started in Africa by facilitating drone deliveries of blood into remote parts of Rwanda. The organisation has since grown its operations to Ghana, Nigeria, and Japan. In Ghana, Zipline has now partnered with Jumia to deliver household items.[98] While it will be some time before drone deliveries become the default, this possible future could mean that motorcycle and vehicle delivery agents will be out of the job.

Service and ride-hailing services such as Uber and Bolt, as well as similarly homegrown solutions, known as Little in Kenya, Gokada in Nigeria, SafeBoda in East Africa, and Move in Rwanda have succeeded at improving the safety and reliability of transport of individuals and delivery of goods. These companies have also created a steady stream of employment for individuals who can drive and own cars or motorcycles. In some countries such as Kenya, Uber has partnered with local banks to provide vehicle financing options which means that even if you do not have a car, you are not locked out of the opportunity. Additionally, AI is being used in fleet management, trackers are added to vehicles, trucks, or motorbikes and these provide the owners with real-time analytics and insight into where their vehicles are and the ability to make real-time decisions.[99]

4.8.1.7 WATER AND WASTE MANAGEMENT

Africa's water and sanitation infrastructure is yet inadequate with 58% of the population able to enjoy access to water and 32% able to access sanitation or waste services.[100] Where the infrastructure does exist, AI techniques can be used to analyse water provision from the sources and this information used to automate and support provision and decision-making. AI can also be used to enhance water quality through the detection of harmful particles in water. When it comes to wastewater, AI techniques can be used to predict the risk of blockages in the sewer network and eliminate the risk of pollution in the region as well as to enhance sewer management and forecasting.[101] These use cases present an opportunity for the supply and installation of sensors along water supply and sewerage lines to enable monitoring. The data analysis decision-making opportunities created in the use of the data captured will create job opportunities for highly skilled labourers.

[95] https://www.gsma.com/mobileeconomy/wp-content/uploads/2022/10/The-Mobile-Economy-Sub-Saharan-Africa-2022.pdf
[96] https://www.teodesk.com/blog/artificial-intelligence-and-machine-learning-applications-within-the-telecom-industry/
[97] https://www.afdb.org/fileadmin/uploads/opev/Documents/Transport_in_Africa_-The_African_Development_Bank%E2%80%99s_Intervention_and_Results_for_the_Last_Decade.pdf
[98] https://www.reuters.com/world/africa/drone-delivery-picks-up-africa-jumia-pairs-with-zipline-2022-09-01/
[99] http://www.securitysa.com/15943r
[100] https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-8457-2
[101] https://www.energymanagermagazine.co.uk/how-can-artificial-intelligence-tackle-the-water-crisis/

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Here are some potential multi-sectoral impacts of AI on work in these sectors:

a) Mining and Energy: The impacts of AI on work in Africa's energy and mining sectors are likely to be significant, affecting various aspects of these industries, including workforce composition, labour practices, safety, productivity, and sustainability.
b) Workforce Composition: AI is likely to change the composition of the workforce in the energy and mining sectors in Africa. With the increasing automation of routine tasks, the demand for manual labour may decrease, while the demand for skilled workers in AI-related areas such as data analysis, programming, and robotics may increase. This shift in the workforce may have implications for education and training programmes to ensure that the labour force has the necessary skills to take on these new roles.[102]
c) Labour Practices: AI may also have an impact on labour practices in the energy and mining sectors in Africa. With the increasing use of AI, companies may rely less on human labour and more on automation, which could lead to concerns about job security and fair compensation for workers. Companies may need to ensure that they have adequate policies and practices in place to manage the transition to more AI-driven operations and ensure that workers are treated fairly.
d) Safety: One potential benefit of AI in the energy and mining sectors is improved safety. AI-powered sensors and monitoring systems can help detect potential safety hazards and prevent accidents. This could help reduce the number of workplace injuries and fatalities, which are significant problems in these industries in Africa.[103]
e) Productivity: AI has the potential to improve productivity in the energy and mining sectors by streamlining processes, reducing downtime, and optimising resource use. For example, AI-powered predictive maintenance systems can help identify equipment issues before they cause a breakdown, reducing the need for costly repairs and downtime. This could help increase efficiency and reduce costs.
f) Sustainability: AI can also play a role in promoting sustainability in the energy and mining sectors in Africa. For example, AI-powered energy management systems can help optimize energy use and reduce waste, while AI-powered monitoring systems can help detect and prevent environmental damage. This could help companies reduce their environmental impact and improve their sustainability performance.

Overall, the impacts of AI on work in the energy and mining sectors in Africa are likely to be complex and multi-faceted, with both positive and negative effects. Companies and policymakers will need to carefully consider these impacts and develop strategies to manage the transition to more AI-driven operations in a way that maximizes the benefits while minimizing the risks.

4.8.2 HOW TO PREPARE FOR AI

African countries should adequately prepare for the new trends that will emerge as AI is increasingly being used in the workplace. Therefore, African countries should ensure their workforce have the necessary skills that are needed to work with AI.[104] Efforts should be implemented to encourage employees to think critically and be innovative since AI is changing the way we work. African countries should also prepare for the changes that AI will bring. For example, in the past, any major technological advancement in the field of communication or transportation has resulted in the creation of new jobs and industries. Thus, with the rise of AI, this trend is not likely to continue. Instead, AI is most likely to eliminate some jobs and drastically change others.[105]

[102] https://www.africa.engineering.cmu.edu/academics/courses/04-800-X.html
[103] Amos, D. M., Jansen van Vuuren, B. L., & Moyo, M. (2020). Big data analytics and machine learning for the management of African elephant populations. Journal of Big Data, 7(1), 1-18.
[104] SJR. 2018. Scimago Journal & Country Ranks. Available at: https://www.scimagojr.com/countryrank.php?category=1702&order=h&ord=desc
[105] CBINSIGHTS. 2018. The Global Unicorn Club (including whisper valuations) Current Private Companies Valued At US$1B+. Available at: https://www.cbinsights.com/research-unicorn-companies

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The best way to protect the workforce from the negative impacts of AI is to enable them to stay ahead of the curve. This entails keeping the workforce's skills and knowledge up-to-date and open to new opportunities since the advancement of AI is inevitable. With the rapid increase in technological capabilities, AI is expected to have a significant impact on the job sector soon. McKinsey Global Institute estimated that by 2030, AI could displace up to 30% of the world's workforce.[106] As AI continues to develop and become more sophisticated, its impact on the job sector will only become more pronounced.

While the impact of AI on the job sector is still relatively unknown, there are a few potential scenarios that could play out. One possibility is that AI will lead to the creation of new jobs that are more efficient and effective than those that currently exist.[107] For instance, AI could be used to automate repetitive and low-skill tasks, thereby, freeing up employees to focus on more complex and higher-level tasks. This would result in the creation of new job positions that require different skill sets. Therefore, the impact of AI on the job sector could be both positive and negative. On the positive side, AI can help automate repetitive tasks and thus improve efficiency. On the negative side, AI can lead to job losses as machines begin to replace human workers in a variety of industries. The benefits are not only evident in the improvement of productivity and efficiency, but also in the improvement of employee engagement.

The International Data Corporation (IDC) reported that more than two-thirds (69%) of employees believe that AI in the workforce will make them more productive workers. It is no wonder, then, that employees are eager to work with AI. Furthermore, Oracle and Future Workplace reported that nearly three-quarters (74%) of employees would be willing to work with an AI-powered assistant. Additionally, more than half (52%) of the employees reported that they will be willing to work with a robot.

But it is not just employees who see the value in AI, employers are also turning to AI to help them improve the workplace. For example, Gartner reported that approximately one-third (32%) of organisations are already using AI in the workplace. Additionally, another 31% of organisations are planning to implement AI-based systems in the next two years. As such, AI is being used in a variety of ways in the workplace such as improving customer service by providing employees with personalized recommendations.

The benefits of AI systems are not only evident in the improvement of productivity and efficiency, but also the morale of the workforce. The reaction of the employees to such a change has been, in a word, phenomenal. Thus, the future of work is a projection of how work, workers and the workplace will evolve in the years ahead in Africa during this emerging 4IR. Most importantly, some reports have speculated that 85% of jobs that will exist in 2030 have not been invented yet.

The seven (7) drivers that are shaping the future of work and these are summarised as follows:

a) ***Enabling Technologies***. Technology is one of the main drivers of change in the workplace. It is enabling organisations to be more agile, to connect with employees and customers in new ways, and to create new types of work. Enabling technologies are also changing the nature of work, making it more collaborative and mobile.

b) ***Office Infrastructure***. Office infrastructure is one of the AI drivers shaping the future of work. AI is transforming the way we work by automating repetitive tasks, providing new insights from data, and enabling new forms of communication and collaboration. As AI capabilities continue to increase, the way we work will continue to evolve.

c) ***Process***. Many experts believe that AI will have a profound impact on the future of work. The process is one of the AI drivers shaping the future of work. Process automation is already transforming many industries, and experts believe that AI will accelerate this trend. AI can help organisations automate repetitive and low-level tasks, freeing up employees to focus on more strategic tasks. In addition, AI can help organisations optimize their business processes, making

[106] https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages

[107] D'Aveni, Richard A. 2018. The 3-D Printing Playbook. Harvard Business Review, July-August 2018, pp. 107-113. Available at: https://hbr.org/2018/07/the-3-d-printing-playbook

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them more efficient and effective. Process optimization is a key driver of AI-powered business transformation.

d) ***Culture***. Culture is one of the AI drivers that are shaping the future of work. With the advent of AI, many jobs that have been traditionally done by humans are now being done by machines. This is causing a lot of changes in the workplace, including the way that work is organised and the way that workers interact with each other. As AI continues to develop and become more widespread, these changes are likely to continue and even accelerate. One of the most significant changes that AI is causing is the way that work is organised in the past, work was often organised around specific tasks that needed to be completed.

   However, AI is changing this by making it possible to automate many tasks. This means that work can be organised around goals rather than specific tasks. This is likely to lead to a more efficient and effective workplace. Additionally, AI is also changing the way that workers interact with each other. In the past, workers often had to communicate with each other in person or over the phone. However, AI is making it possible for workers to communicate with each other through chatbots and other digital channels. This is likely to lead to a more efficient and effective workplace.

e) ***New Business Models***. New business models are one of the AI drivers that are also shaping the future of work. AI is changing the way businesses operate and the way work is done. In this way, AI technology is also changing the nature of work itself, making some jobs obsolete and creating new ones. As businesses adopt AI, they will need to adapt their business models to stay competitive. This will require African businesses to rethink their strategies, their organisational structures, and their business models.

f) ***Skills for the Future***. Skills for the future are one of the AI drivers shaping the future of work. This is because AI is changing the way work is done and the skills that are needed to do it. For example, AI is changing the way marketing is done. In the past, marketing was about creating and distributing content. However, today AI is being used to create and distribute content. This means that the skills that are needed to do marketing are changing.

g) ***Policy***. The policy is one of the AI drivers shaping the future of work because it has the potential to impact the development and deployment of AI technologies. For example, the policy can influence the types of data that are collected and used to train AI systems, as how AI systems are deployed and regulated. In addition, the policy can also help the policy shape the social and economic context in which AI technologies are used, which can impact the types of jobs that are created and how work is organised.

   In many developing countries, about two-thirds of workers remain in low-productivity jobs, often in informal sector firms with poor access to technology. Informality has remained remarkably stable despite economic growth and the changing nature of work. Addressing informality and the absence of social protection for workers is a pressing concern for emerging market economies. Of course, the risk of large sections of the poor, the low-skilled, and the uneducated being left behind in a so-called digital divide loom large as more than 60% of the labour force is made up of ill-equipped adults and almost 90% of the total employment is in the informal sector.
   Particularly, AI technology is reshaping the skills needed for work. Although the demand for less advanced skills is declining, the demand for advanced cognitive, socio-behavioural, and adaptable skills is rising. As a result, it is not just that new jobs are replacing old jobs but also that existing jobs increasingly require a different set of skills. Furthermore, technology is disrupting the nature of firms such that platform-based businesses like Amazon and Airbnb outcompete traditional brick-and-mortar companies such as retail stores and hotels. Platform companies create a network effect that connects customers, producers, and providers; and the companies facilitate interactions through multi-sided business models.

4.8.3 ADJUSTING TO AI IMPACTS IN THE JOB SECTOR

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The potential for AI to redefine work is considerable and AI technology is already reshaping work in many industries. In the future, AI will have an even greater impact on the workplace as it becomes more ubiquitous, and its capabilities expand. This is because AI is already being utilised to automate routine tasks and to augment human capabilities.[108] For example, AI-enabled chatbots are being used to provide customer service, and AI is being utilised to generate insights from data that can help businesses make better decisions. As AI technology advances, the technology will enable even more sophisticated applications, such as predictive maintenance and autonomous vehicles. In this case, AI is used to detect potential equipment failures before they even occur and formulate preventative mechanisms and protocols.[109]

The impact of AI on the workplace will be both positive and negative. On the positive side, AI will create new opportunities for workers in a wide range of occupations, from healthcare to manufacturing. AI will also help businesses become more productive and efficient.[110] On the negative side, AI will automate many tasks that are currently performed by human workers, which could result in job losses. Therefore, to address these potential losses and exploit the advantages of AI technology, the following recommendations should be considered:

a) Policymakers should consider the potential impacts of AI on the workplace and implement the necessary preventative steps and interventions to ensure that the benefits of AI are broadly shared. For example, although the rapid adoption of mobile payments such as M-Pesa led to the loss of approximately 6,000 banking sector jobs between 2014 and 2017 in Kenya, the number of mobile payment agents increased by almost 70,000, resulting in a direct net positive job effect.[111]

b) The World Economic Forum used LinkedIn data to conclude that the greatest long-term benefits of information and communication technology–intensive are likely to be in digital design, creation, and engineering. The report suggested that to build a pipeline of future skills, African educators should design future-ready curricula that encourage critical thinking, creativity, and emotional intelligence.[112] African countries should also accelerate the acquisition of digital and science, technology, engineering, and mathematics (STEM) skills to match the way people will work and collaborate in the future.[113]

c) Moving forward, short-to-medium-term policies should focus more on increasing productivity and implementing interventions to upgrade skills for informal, small-scale enterprises, small-to-medium farming businesses, and unskilled workers.

4.8.4 LEVERAGING AI FOR WORK

AI is transforming the way we work; AI is automating many tasks that have traditionally been done by humans and changing the nature of work itself. Therefore, as AI is continually evolving and becoming more sophisticated, its impact on the workplace will only become more pronounced.[114] Thus, this section explored some of the mechanisms and methodologies through which AI can impact the workplace and workforce. The section also explored the implications of these AI-enabled changes to formulate what policymakers can do to ensure that workers can adjust and thrive in the face of these changes.

[108] https://www.dni.gov/files/ODNI/documents/assessments/GlobalTrends_2040.pdf
[109] https://www3.weforum.org/docs/WEF_National_AI_Strategy.pdf
[110] https://www.oecd.org/science/tools-for-trustworthy-ai-008232ec-en.htm
[111] UK. 2016. The Quantum Age: technological opportunities. UK Government Office of Science. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/564946/gs-16-18-quantum-technologies-report.pdf
[112] WEF. 2017.These are the 25 most high-tech cities in the world. World Economic Forum. Available at: https://www.weforum.org/agenda/2017/08/these-are-the-25-most-high-tech-cities-in-the-world.
[113] https://www.up.ac.za/media/shared/7/ZP_Files/ai-for-africa.zp165664.pdf
[114] https://Africanaiethics.com/wp-content/uploads/2022/02/Artificial-Intelligence-African-Insight-Report.pdfhttps://www.researchgate.net/publication/337503231_Artificial_intelligence_policies_in_Africa_over_the_next_five_years

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a) A 2018 report on regional perspectives on the future of work argues that new technologies will play an increasingly important role in Africa's economic transformation in agriculture, manufacturing, modern services, local content, and infrastructure.[115]

b) Third, on the endowments (skills) side, low levels of human capital provide ample scope to develop worker-enhancing digital technologies that can be adopted by businesses across Sub-Saharan Africa, in the formal and informal sectors. Many digital technologies accessible through the internet—digital financial services for low-income entrepreneurs and the unbanked, voice and video-based e-extension services for informal farms and firms, and Uber-like platforms that do not require reading and numeracy skills—are particularly well-suited for the types of less educated, less skilled workers who are more prevalent in Sub-Saharan Africa than in other, higher-income regions.[116]

c) To avoid the risks of a worsening digital divide, internet services should be affordably available in rural as well as urban areas, in secondary as well as primary cities, for women as well as men, and older as well as younger people.

4.9 EDUCATIONAL CURRICULUM REVIEW

Over the past few years within the African continent, progress within the education sector has advanced. According to the Transforming Education in Africa report published by UNICEF in 2021, the percentage of primary-school-aged children who are not enrolled in school has decreased by half from 2000 to 2019.[117] For lower secondary and upper secondary school, this percentage has decreased by 10% respectively. Despite this, there still exist 105 million children who are out of school and for those enrolled in schooling, the education is often substandard. The UNICEF report states that 87% of children lack functional literacy skills, with only 35% of children competent in reading. Additionally, factors such as education costs, a lack of qualified teachers, and political instability also contribute to poor learning outcomes.[118]

The COVID-19 pandemic also exposed weaknesses in education systems around the world, but especially within African countries. While some countries were able to provide remote learning, about 121 million students had no access at all.[119] To begin a change towards quality education for all students within Africa, African governments need to invest in free, high-quality education along with infrastructure to support digital learning, which will likely stay in place long after the pandemic. In addition to strengthening existing curricula along with incorporating relevant digital skills such as typing and basic programming starting as early as possible. Secondary and tertiary schooling systems should also invest in computer programming, machine learning, and AI courses to support training in these vital fields. As the shift begins towards preparing economies across the world for the 4th Industrial Revolution, digital literacy will become an important facet of primary and secondary school education within Africa.[120]

4.9.1 DIGITAL SKILLS TRAINING IN AFRICAN EDUCATIONAL CURRICULA

[115] AfDB, ADB, EBRD, IDB (African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank). 2018. The Future of Work: Regional Perspectives.
[116] Clarivate Analytics. 2017. Highly Cited Researchers. Available at: https://hcr.clarivate.com/researchers-list/archived-lists/.
[117] UNICEF. "Transforming Education in Africa: An evidence-based overview and recommendations for long-term improvements". https://www.unicef.org/reports/transforming-education-africa (2021)
[118] Devlin, Will, Sarah Woods and Brandan Coates. 2011. Commodity price volatility. Economic Roundup Issue 1, 2011, Australian Treasury. Available at: https://treasury.gov.au/publication/economic-roundup-issue-1-2011/economic-roundup-issue-1-2011/commodity-price-volatility/
[119] UBI. 2018. Ranking: Top Business Incubator — Managed by University — 2017/2018. Available at: https://ubi-global.com/ranking-top-business-incubator-managed-university-2017-2018/.
[120] Khanna, Parag, 2016. How much economic growth comes from our cities? World Economic Forum. Available at: https://www.weforum.org/agenda/2016/04/how-much-economic-growth-comes-from-our-cities/

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Within the African continent, primary and secondary education rarely covers digital skills training such as typing, coding, and logic. However, there is progress being made to change this. Kenya, the first country in Africa to do so, has instituted plans to require a programming curriculum to reach students as early as primary school.[121] However, such training is not sufficient to address the lack of skilled AI/ML researchers and programmers to actively bring African countries to par with other economies such as the United States of America, Canada, India, and Brazil. To close this gap, initiatives by large technology companies such as Google[122] and Microsoft,[123] in partnership with the African Development Bank, have emerged to provide African students and professionals with training. Local initiatives such as the Africa Women Innovation & Entrepreneurship Forum (AWIEF)[124] are focusing on digital skills training for young women in South Africa. As the potential of AI and ML start to be realized in Africa, local organisations such as Data Science Nigeria, AI Saturdays Lagos, Deep Learning Indaba, Masakhane NLP, and Ghana NLP among others have emerged to support students and researchers in pursuing careers in AI/ML.[125]

More formal education programmes have also been recently established to support tertiary school training in AI/ML. The African Institute of Mathematical Science (AIMS) was established in 2018 in collaboration with Google and Facebook and has opened centres in Ghana, Rwanda, Senegal, Cameroon, and South Africa to provide students with opportunities to complete master's degrees in AI and machine learning. For instance, the Carnegie Mellon campus in Rwanda was established in 2011 with a similar goal to provide advanced training and STEM degrees to African students.[126] Additionally, research laboratories at top African universities such as Makerere University in Uganda and the University of Cape Town in South Africa have shown strong promise for supporting the upcoming generation of AI researchers.

However, more funding for graduate students is needed to support and build a strong pipeline of researchers and professors focused on addressing problems in AI/ML. Researchers from the World Bank have shown that compared to middle-income countries around the world, tertiary enrolment in engineering fields is severely lacking. Furthermore, doctoral collaboration training and funding programmes such as those from Google[127] and DeepMind[128] which currently support students at institutions such as Stellenbosch University, University of Witwatersrand, Makerere University, and AIMS Rwanda have been instrumental in supporting scholars studying in these fields. Additionally, African governments can allocate funding and create fellowships to support advanced training for students and researchers.

Along with investments in digital infrastructure, African governments should prioritise investing in STEM training for African secondary school teachers to provide solid teaching in these respective skills. Such initiatives can be supplemented by existing tools popular in the United States of America and other countries such as Google Classroom, MIT Scratch, Blockly, and other visual-based programming tools. However, these initiatives are not an all-in-one panacea for addressing problems unique to the African education system. Work should also be undertaken by local researchers to develop context-specific curricula and novel pedagogical approaches to training African students in relevant STEM skills. Additionally, African governments can partner with venture capital and private equity firms to support local startup companies working to develop educational technologies that fit the needs of African educators and students. Overall, there exist many challenges to address in improving the state of the educational curriculum in African schools and universities. However, with collaboration and dedicated focus, new initiatives and specialized curricula can help develop a workforce prepared to advance the state of AI/ML within the continent.

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[121] https://techcabal.com/2022/08/08/kenya-becomes-the-first-african-country-to-teach-coding-as-subject-in-schools/
[122] https://learndigital.withgoogle.com/digitalskills
[123] https://www.afdb.org/fr/news-and-events/press-releases/african-development-bank-launches-digital-tool-help-african-youth-learn-code-33028
[124] https://www.awieforum.org/digital-skills-training-2022/
[125] The Economist. 2013. Not always with us — The world has an astonishing chance to take a billion people out of extreme poverty by 2030. Print edition briefing. June 1, 2013. Available at: https://www.economist.com/briefing/2013/06/01/not-always-with-us.
[126] WEF. 2018. The Global Competitiveness Report 2018-19. World Economic Forum. Available at http://www3.weforum.org/docs/GCR20i18/05FullReport/TheGlobalCompetitivenessReport2018.pdf
[127] https://research.google/outreach/phd-fellowship/
[128] https://www.deepmind.com/scholarships

To support the needs of the African continent in preparing for the 4th Industrial Revolution we lay out **6 priority domains** for improving education:

a) ***Investing in digital infrastructure to support remote learning.*** To help support learning that takes advantage of digital methods, access to the Internet is crucial. While large tech companies such as Google, and Meta have established subsea cables to help connect African countries to faster internet, African governments should invest in infrastructure to improve cross-continent coverage. Governments can also supplement these recommendations to establish digital hubs in schools and community centres where students and community members can have broader access to computers and the Internet. To support at-home learning for disadvantaged students, governments should also provide funding to schools to distribute mobile Wi-Fi hotspots and laptops.

b) ***Increasing STEM skills training for educators.*** To enable effective learning environments, educators should be well-versed in the latest teaching methods in STEM subjects. Governments should invest in upskilling and reskilling workshops by bringing in domestic and international education experts. Additionally, governments can supplement such training by leveraging open-source online modules. To verify the capabilities of educators, African school systems should also invest in licensing systems (teaching credentialing, self-assessments, certification exams, etc.) to create pedagogy standards and ensure that educators are sufficiently specialized in their respective subject matters.

c) ***Updating STEM curriculum.*** To ensure that African students are provided optimal education, STEM curriculum within African education institutions should be updated to align with international standards. Additionally, teachers, students, and administrators should provide feedback on this curriculum to ensure that it meets students' needs and is relevant to the context. STEM curriculum should not solely focus on theory but engage practical and hands-on applications to provide students with real-world examples. Additionally, secondary, and tertiary curricula should leverage co-ops and internships to build professional and career skills.

d) ***Supporting AI research laboratories at universities.*** Academia provides a strong foundation for fundamental research across all areas of science and technology. To support the development of novel research methods that help advance African interests and address local needs, governments should institute or increase funding for grant support to help African universities establish, maintain, and grow thriving research laboratories.

e) ***Increased funding for post-secondary education in priority STEM fields.*** To help build a solid research and development pipeline of master's and PhD-level graduates to support the workforce, African governments and private institutions need to invest in post-secondary education in priority STEM fields like computer science, data science, and human-centred design. Governments should also focus on providing teaching and research stipends to support graduate-level education.

f) ***Forging industry-government partnerships***. To help advance current initiatives and develop new ones, governments can forge industry partnerships with small and large technology companies throughout the continent. These partnerships can include funding for education, grants for technology licenses and equipment, and funded career opportunities for students.

4.9.2 MINDSET CHANGE

Ensuring a mindset change in Africa for progress in AI will require a multifaceted approach that involves various stakeholders, including governments, private sector organisations, academic institutions, civil society organisations and non-governmental organisations. A mindset change in Africa for progress in AI requires a holistic approach that involves education, skill development, partnerships, incubation, policy and regulation, and collaboration. By investing in these initiatives and programmes, Africa can leverage

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the benefits of AI to drive economic growth, improve quality of life, and achieve sustainable development.[129]

Here are some strategies that can help foster a mindset change in Africa towards AI:

Education and awareness creation: Education and awareness creation are critical in changing mindsets. Governments, development partners and private sector organisations can support education programmes that teach AI and its potential benefits. Workshops, seminars, and training programmes can also help raise awareness about AI and its potential applications.

Investment in research and development: Research and development are essential for developing innovative solutions and applications for AI. Governments, private sector organisations, and academic institutions can collaborate to invest in AI research and development initiatives.[130] An example is AI for Development: This is a program that seeks to promote AI in Africa by building the capacity of developers, researchers, and policymakers. The program aims to help African countries leverage AI to solve some of their most pressing problems, such as poverty, food insecurity, and healthcare.

Encouraging innovation and entrepreneurship: Governments and private sector organisations can provide incentives and support for innovation and entrepreneurship in AI. This can include funding, mentorship, and access to resources.

Collaboration and partnerships: Collaboration and partnerships are crucial in driving progress in AI. Governments, private sector organisations, and academic institutions can collaborate to share knowledge, expertise, and resources. For example, AI Hackathons: These events bring together developers, designers, and entrepreneurs to work on AI-based solutions to local problems. Hackathons can help foster a culture of innovation and creativity while also providing an opportunity for participants to learn more about AI.

Addressing ethical and social issues: AI raises ethical and social issues that need to be addressed. Governments, private sector organisations, and civil society organisations can work together to develop ethical guidelines and policies for AI. An excellent opportunity is through AI Ethics and Governance: This initiative focuses on promoting responsible AI development and use in Africa. The program aims to build awareness among policymakers and the public about the ethical and social implications of AI and to provide guidance on best practices for AI governance.[131]

Embracing diversity: Diversity is essential in ensuring that AI is developed with a global perspective. Governments and private sector organisations can promote diversity in AI research and development teams. Developing policies and regulations that encourage responsible AI development and use can help ensure that AI is used to benefit society. Organisations like the Partnership on AI and the AI for Good Global Summit provide a platform for policymakers to share best practices and collaborate on AI policy development.[132]

Therefore, ensuring a mindset change in Africa for progress in AI will require a collaborative effort from various stakeholders. By investing in education, research, innovation, and partnerships, Africa can leverage the potential of AI to drive economic growth and social development.

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[129] https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/59999/27ea1089-760f-4136-b637-16367161edcc.pdf?sequence=1&isAllowed=y

[130] Times Higher Education. 2018. Times Higher Education World University Rankings 2018. Available at: https://www.timeshighereducation.com/world-university-rankings/2018/world-ranking#!/page/0/length/25/sort_by/rank/sort_order/asc/cols/stats

[131] UNESCO. 2017. Managing tomorrow's digital skills — what conclusions can we draw from international comparative indicators? Available at: http://unesdoc.unesco.org/images/0026/002618/261853e.pdf

[132] WEF. 2016. The Global Competitiveness Report 2016-17. World Economic Forum. Available at: http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf

4.10 A NEW APPROACH TO RESEARCH, DEVELOPMENT, AND INNOVATION IN AI

To become one of the most innovative regions in the world, Africa should build a culture of innovation, where Africans can embrace change and have the right skill sets and tools to leverage emerging opportunities to compete in the global economy. The plan builds on Africa's innovation strengths and addresses areas of weakness along the innovation continuum. This is from the people and skills to fundamental and applied research, building innovation ecosystems, commercializing ideas and starting-up companies, to exporting and scaling up globally competitive companies across all sectors of the economy.[133]

There is a growing interest in the development of AI in Africa, and there are several new approaches that can be taken to foster research, development, and innovation in this area.

Collaborative partnerships: One approach is to foster collaborative partnerships between African institutions and established AI research organisations worldwide. This would help to build capacity, transfer knowledge, and develop local talent. Such partnerships would also provide access to resources and funding, which is often a major challenge for African researchers.

Africa's largest R&D institute, the ARC will have a track record of bringing its national network of researchers and scientific facilities to bear on Africa's most pressing and immediate challenges. World-class research requires researchers across scientific disciplines to rapidly process, exchange, share, and visualize vast amounts of data. ARC is building the capacity to deliver leading exploratory and applied research. The Intellectual Property Strategy provides African researchers and businesses with access to new IP resources. Its three-pronged approach focuses on awareness, education, and strategic IP tools for growth.

It will also support training for employees who deal with IP in innovation programmes. Africa's Plan for the Fourth Industrial Revolution (IP) is aimed at three areas: attracting investment, supporting the growth of African companies and start-ups, and exporting. First, the IP Strategy aims to reduce transaction costs for businesses and researchers and improve entrepreneurs' access to public sector-owned intellectual property (IP).

Education and training: Education and training are critical to the development of AI in Africa. Governments and educational institutions can invest in AI education and training programmes that equip students with the skills and knowledge necessary to develop AI solutions. This would help to build a strong talent pool and promote innovation.

An exceptional contribution to this education and training for all people across the continent is to introduce an initiative known as AFRICAN CODE. This initiative will aim to have 11 million Africans no matter their education and experience get to learn and experiment with coding as a basic knowledge. Particularly, over 1 million instructors and teachers will benefit from this. The target is to do this by the end of March 2030. The project aims to inspire one million young Africans a year to pursue a career in science, technology, engineering, or mathematics.

Addressing local challenges: Developing AI solutions that address local challenges is also critical. Africa has unique challenges, such as inadequate healthcare systems, poor infrastructure, and food insecurity. By developing AI solutions that address these challenges, African countries can not only improve their quality of life but also contribute to global progress.

Young Africans are increasingly changing their careers multiple times throughout their lifetimes. To support these transitions, several initiatives support lifelong learning and upskilling. The Future Skills initiative brings together expertise from all sectors to identify the skills sought and required by employers. It also aims to explore new and innovative approaches to skills development. The First Nations and Inuit

[133] Transport Systems Catapult, 2017. Market Forecast for Connected and Autonomous Vehicles. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/642813/15780_TSC_Market_Forecast_for_CAV_Report_FINAL.pdf

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Youth Employment Strategy will have two streams offering valuable work experience. Connect to Innovate program aims to provide rural and remote regions across Africa with high-speed, broadband internet access. The Innovation and Skills Plan aims to address digital divides by ensuring all Africans can fully participate in the digital economy.

Promoting entrepreneurship: Encouraging entrepreneurship is another approach to promoting AI development in Africa. Governments and private sector organisations can provide funding and support for start-up companies that focus on AI, and they can also provide access to training and mentorship programmes. This approach would not only promote innovation but also create job opportunities and economic growth. Africa's Grand Challenges Plan aims to challenge African innovators to think beyond what is possible today to develop novel solutions to cross-cutting challenges with broad commercial potential. Modelled on international best practices of competitive countries, this enables Africans to be bold and creative and imagine and deliver innovations that can change the world. Africa will become a nation of innovators with a healthy innovation culture, and all Africans should be able to participate fully in the economy of the future. The Innovation and Skills Plan is implementing targeted initiatives to give these groups access to skills, technologies, funding, and other resources. Africa should leverage areas of strength to become one of the most innovative countries in the world. To win the innovation race, Africa should produce more export-oriented, globally competitive large firms. Firms need effective and efficient support to grow and help Africa become a nation of innovators.

Data availability: Data availability is a major challenge for AI development in Africa. To address this challenge, African governments can invest in data infrastructure and also encourage data sharing among organisations. This would not only improve the quality of AI research but also foster collaboration and innovation.

Africa is in a time of unprecedented transformation, and Africans should be equipped with the right competencies to meet the evolving demands of the workplace. To grow and scale up, firms should be able to fill skills gaps, by gaining better access to global talent and recruiting from a broader, deeper pool of talent. African Code works through 53 national, regional, and local not-for-profit organisations to support school-age opportunities for coding and digital skills development. It can provide coding training to 1 million students, of which more than 40% are girls and 8.5% are Indigenous.

Another important benchmark is to make use of work-integrated learning opportunities.

Work-integrated learning (WIL) is an educational approach that combines classroom learning with practical work experience. WIL has proven to be an effective way to equip students with the skills and knowledge they need to succeed in their future careers. In the context of AI in Africa, WIL can play a crucial role in supporting the development and deployment of AI technologies.

One way to support WIL in AI in Africa is through partnerships between academic institutions and industry. These partnerships can provide students with opportunities to work on real-world AI projects and gain hands-on experience. Industry partners can also provide mentorship and guidance to students, helping them to develop the skills and knowledge needed to succeed in the workplace.

Another way to support WIL in AI in Africa is through the development of specialized training programmes. These programmes can be designed to provide students with a deep understanding of AI technologies and their applications in specific industries. By focusing on the practical aspects of AI, these programmes can help students to develop the skills they need to succeed in their future careers.

Finally, government support is essential in promoting WIL in AI in Africa. Governments can provide funding and other resources to support partnerships between academic institutions and industry. They can also develop policies and initiatives to promote the development and deployment of AI technologies, creating new opportunities for students to gain practical experience in the field.

There are several countries and initiatives in Africa that support work-integrated learning to support AI. Here are some examples:

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South Africa: The South African government has launched the National Integrated Information and Communication Technology (ICT) Skills Strategy to support the development of digital skills in the country. The strategy includes work-integrated learning programmes to help students gain practical experience in AI and other emerging technologies.

Ghana: The Ghana Tech Lab is a government initiative that provides work-integrated learning opportunities for students in the technology sector. The lab offers training programmes in AI, machine learning, and other emerging technologies to help students gain practical experience.

Kenya: The Kenya Education Network (KENET) has partnered with the IBM Digital - Nation Africa program to provide work-integrated learning opportunities for students in AI and other emerging technologies. The program offers free online courses and hands-on training to help students develop practical skills.

Rwanda: The Rwanda Coding Academy is a government initiative that provides work-integrated learning opportunities for students in coding and AI[134]. The academy offers a three-year program that includes a six-month work-integrated learning experience to help students gain practical experience.

Egypt: The Information Technology Institute (ITI) in Egypt offers work-integrated learning programmes in AI and other emerging technologies. The programmes include internships and apprenticeships with industry partners to help students gain practical experience.

Many other countries and organisations are also working to develop the skills and knowledge needed to drive AI innovation in Africa. As such, WIL can play a critical role in supporting the development and deployment of AI technologies in Africa. By providing students with practical experience, specialized training programmes, and government support, we can ensure that the next generation of AI professionals in Africa is well-equipped to address the challenges and opportunities of the 21st century. Interestingly, there have been several private sector initiatives supporting AI in research, education, agriculture, and indigenous technology scaling across Africa.

Here are some examples:

Data Science Nigeria: This is a non-profit organisation that aims to build a community of data scientists and AI experts in Nigeria. They provide training, mentorship, and research opportunities to students, professionals, and researchers interested in data science and AI. Currently, over 200,000 students and people have benefited from this initiative that provides mentorship and career opportunities as well.

Zindi: This is a platform that connects African data scientists with organisations looking to solve complex problems using AI. Zindi hosts competitions, hackathons, and challenges where data scientists can showcase their skills and collaborate with other experts across the continent. For the past 3 years over 20 competitions have been held on the platform to support Agriculture, climate change and financial solutions in Africa.

IBM Research Africa: IBM has a research lab in Nairobi, Kenya, which focuses on developing AI solutions for Africa's unique challenges. They work on projects related to healthcare, agriculture, financial inclusion, and education, among others.

African Institute for Mathematical Sciences (AIMS): AIMS is a network of research centres across Africa that focuses on mathematical sciences. They offer master's and PhD programmes in data science and mathematical modelling, which include courses on AI and machine learning. This institution has campuses in Rwanda, South Africa, Ghana, and Senegal.

Deep Learning Indaba: This is an annual conference that brings together experts in deep learning and AI from across Africa and the world. The conference aims to promote knowledge sharing, collaboration,

[134] https://www.minict.gov.rw/news-detail/rwanda-launches-the-first-coding-academy

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and networking among AI researchers and practitioners in Africa. Indaba is organised across the continent for researchers and practitioners to share knowledge advances with the audience.

AI Hub Africa: This is a startup accelerator program that focuses on AI-based start-up companies in Africa. They provide mentorship, funding, and resources to help start-up companies grow and scale their AI solutions.

Moringa School: This is a tech school based in Nairobi, Kenya, that offers courses on software engineering, data science, and AI. Their AI course covers topics such as natural language processing, computer vision, and deep learning.

Wazihub: Wazihub is an innovation hub that focuses on developing IoT (Internet of Things) solutions for Africa. They offer a platform that enables developers to build and deploy IoT solutions easily, which can include AI and machine learning capabilities.

There are many more organisations, initiatives, and programmes working towards this goal including ALX and the Room, Blossom Academy, and Runmila Institute in Ghana, and they all play an important role in advancing AI on the continent.

4.11 RECOMMENDATIONS

The recommendations for the human capital in AI, are summarised as follows:

a) **Imparting basic to intermediate digital skills to the digitally unskilled workforce:**

The workplace has already started to change with the inclusion of more and more digital tools and processes to increase efficiency and better work experience. To take full advantage of this change in the workplace, the current workforce needs to be upskilled and those who will be joining the workforce in the future need to be trained accordingly. Systems need to be put in place to train the current the future workforce with basic to intermediate digital skills as per their needs. This needs to be done in different languages such as English, French, and other dominant regional languages. The upskilling and the training of the workforce need to be done jointly by the government, industry, and academia.

b) **An African open-source platform in multiple African languages (for both Anglophone and Francophone audiences) to impart intermediate to advanced skills:**

To take full advantage of the fourth industrial revolution of which AI is one of the main drivers the African continent needs to actively participate and contribute to this AI-driven revolution. To actively contribute to the revolution there is a need for large human capital who are knowledgeable about AI technology. This can be done by training many young people across the continent with intermediate and advanced skills in AI through open-source online platforms. The content of these platforms will benefit entrepreneurs, product developers, researchers etc. The contents on the platform should cater to both the Anglophone and the francophone audience.

c) An Innovation and Skills Plan to drive transformation in businesses:

The Innovation and Skills Plan has driven a historic transformation of business innovation programmes. The new easy-to-navigate suite of programmes is responding to the challenges and opportunities facing African businesses today and into the future. The Innovation Africa single window platform delivers both the four flagship programmes that target critical stages of firm growth, and a completely new suite of business innovation supports. However, the substantial progress in program simplification and consolidation is only the beginning of what can be accomplished through the Innovation and Skills Plan**.**

d) Establishment of an African AI Research Institute (AAIRI):

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To actively participate in the revolution driven by AI, countries need to join hands and utilise their strengths to contribute to the body of knowledge. The establishment of an African AI Research Institute (AAIRI) will assist in fulfilling this aim. The AAIRI will be in multiple countries both physically and virtually working in tandem with each other towards knowledge, quality human resource and intellectual property creation. AAIRI will also work around legislation and human rights-related issues. These include algorithmic transparency, unfairness, bias, discrimination, accountability, negative effects on employees, privacy and data protection, and liability for damage.

e) Establishment of an African Digital Entrepreneurial Institute (ADEI):

It is expected that SMMEs will be one of the major contributors to the economy shortly. There is a need to create a conducive environment the SMMEs to flourish and contribute positively to the economy. The proposed institute will drive AI/digital-related entrepreneurial activities in the continent. The African Digital Entrepreneurial Institute will be a distributed structure with nodes in multiple countries.

f) Micro-credentials for lateral entry into the AI world:

The world of AI is a multidisciplinary field. There is a need for the creation of pathways for people from various fields to contribute to the field of AI. These pathways can be created through micro-credentials for lateral entry into the world of AI.

g) African talent hunts through AI networks:

AI-related network systems should be installed to work together with the existing networks working in the field of AI and to create new networks. These include DSA, and Deep Learning Indaba, among others. This will assist in finding talents in the field of AI, who may be further nurtured the other instruments such as the African Digital Entrepreneurial Institute, and African AI Research Institute, among others.

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5 PILLAR 2: INFRASTRUCTURE AND DATA: FOUNDATIONS AND USE IN AI SYSTEMS

5.1 INTRODUCTION

Data is one of the key elements that drive artificial intelligence systems. The availability, quality, and sources of data are key factors to consider while building accurate and reliable AI solutions. The Markets and Markets reported that the global big data market size was valued at US$138.9 billion in 2020 and is projected to reach US$273.4 billion by 2026.[135] The report showed that the volume and use of data are continuously growing due to the rise of emerging technologies, especially Artificial intelligence. On the other hand, in Africa, market, the big data market, which was valued at US$1.98 billion in 2020, is projected to grow at a compound annual growth rate (CAGR) of 22.3% between 2021 and 2026.[136] This is demonstrating that Africa has the potential to contribute and benefit from this global market value.

Creating a robust data infrastructure and making significant investments in data utilisation is imperative for Africa to foster effective data-driven value creation and drive AI innovation. However, the continent currently faces challenges as the global race for AI technological supremacy unfolds, with Africa lagging in what is commonly referred to as the fourth industrial revolution. This lag puts Africa at risk of digital colonisation, where other regions and countries gain dominance and control over the digital landscape, limiting Africa's ability to shape its technological future. To mitigate this risk, African countries should prioritise accelerating efforts in building data infrastructure, promoting data literacy, fostering local innovation, and establishing collaborative partnerships to ensure that Africa's interests and perspectives are represented in the global AI landscape. By doing so, Africa can assert its position, leverage its unique strengths, and harness the transformative potential of AI for the benefit of its people and sustainable development.

African governments are being encouraged to address data challenges in Africa and assess the viability of the different parts of AI which have the potential to aid governments all around the globe to provide public services as well as ensure that Africa has data and AI sovereignty. Global countries such as the USA, China and the European Union are already integrating AI into their operations and service delivery. These efforts are aimed to enhance productivity, save time and money, and provide higher-quality public services. All these countries have defined national policies and strategies that enable access to quality data for value addition and innovation. However, for Africa to catch up on these advances, there should be significant investments in infrastructure to enhance the capacity to handle AI technology.

Significant efforts are underway to incorporate Africa into the global AI landscape. This is evident through the development of key initiatives such as the African Union (AU) Data policy framework, which aims to establish guidelines and regulations for data governance across the continent. Additionally, the AU Convention on Cybersecurity and Personal Data Protection demonstrates Africa's commitment to addressing cybersecurity challenges and safeguarding personal data. Furthermore, discussions are taking place to explore the adoption and domestication of UNESCO's recommendations on ethical artificial intelligence, highlighting Africa's recognition of the importance of ethical considerations in AI development and deployment. These initiatives reflect Africa's proactive approach to shaping its digital future, fostering innovation, and ensuring responsible and inclusive AI practices that align with the continent's values and priorities.

1.1 SCOPING THE MARKET

[135] https://www.marketsandmarkets.com/Market-Reports/big-data-market-1068.html.
[136] https://www.invesco.com/us-rest/contentdetail?contentId=d07c93e528bf7410VgnVCM100000c2f1bf0aRCRD&dnsName=us&title=bofa-ml-blue-revolution-a-global-water-primer.

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The African continent is experiencing a continuous evolution in the realm of big data, primarily due to the significant increase in data production. This surge can be attributed to various factors, including the expansion of internet connectivity, the proliferation of mobile devices, the widespread use of social media, the rise of e-commerce transactions, the accumulation of healthcare data, government initiatives, and the adoption of transformative technologies like the Internet of Things (IoT) and Artificial Intelligence (AI). These diverse sources of data are continuously expanding across the continent, fuelling the growing demand for data, and reshaping the dynamics of data production and consumption in Africa.

The market size for data centres in Africa is expected to surpass US$3 billion by 2025, with a compound annual growth rate of over 12%. Additionally, this is also due to major global cloud services providers such as AWS, Microsoft, and Huawei that have shown increasing interest in the sector over the past years. APET notes that the current data infrastructure is not prevalent on the African continent, but some countries are thriving in the data industry and have made a lot of investments in building the right foundations to host robust data centres.

In the African continent, South Africa has been recorded to hold the largest market share for data centres due to the country's digital economy which contributes 6 % to its today's GDP of over US$315 billion. In addition, Nigeria is also an established market for data centres, with a GDP of US$482 billion. On the other hand, Kenya is an emerging market for data centres with 46 internet users per 100, with ten colocation data centres, 23 cloud service providers, and two network fabrics in its connectivity ecosystem. Egypt and Morocco have a growing digital economy and several data centres and server farms.

It is also relatively expensive to run data centres in Africa when compared to other parts of the world such as Europe. For example, there are only around 80 data centres across Africa, while France alone, with a population that is 15 times smaller than Africa, operates 200 data centres. This is demonstrating the significant operational differences and gaps. The reason for such differences, among others, can be attributable to the expensive costs of operating data centres in Africa than those in Europe. Furthermore, the regulatory framework for data centres is not yet fully developed and matured in Africa. As a result, this is impeding the full realisation, access, and impacts of data centres in Africa.

The establishment of data centres depends on several key factors, including the quality of internet infrastructure, availability of high-speed internet and reliable exchange rates, the presence of reliable cloud computing services and providers, the availability and reliability of fibre operators, power requirements, and land availability. These factors play a crucial role in determining the feasibility and effectiveness of data centre construction. For example, countries with robust internet infrastructure and a wide range of cloud providers, such as South Africa, Kenya, and Nigeria, are better positioned to support the development of data centres. Additionally, regions with reliable power supplies, such as Morocco and Egypt, offer favourable conditions for data centre operations. Moreover, African countries with ample land resources, such as Tanzania and Angola, have the potential to accommodate large-scale data centre facilities. Considering these factors can enable African countries to strategically plan and develop data centres that can meet the growing demands of digital transformation and data-driven industries.

For instance, the concentration of African data in offshore locations, particularly in Marseille, France, has significant implications for the economic advancement of Africa.[137] The reliance on foreign gateways limits the ability of African operators to provide premium data transfer speeds and hinders the growth of local data-driven industries. This situation has sparked a growing concern for data sovereignty across the continent, prompting a shift in attitudes toward data governance and the establishment of laws and regulations.

By prioritising data sovereignty and developing local data infrastructure, African countries can unlock substantial economic benefits. For example, improving internet connectivity and building robust data

[137] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/2018AEO/African-Economic-Outlook-2018-North-Africa.pdf.

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centres within the continent can attract foreign investments and spur the growth of digital industries. This, in turn, can create employment opportunities, foster innovation, and drive economic development.

Furthermore, by retaining data locally, African nations can leverage their data resources to fuel economic growth and support sectors such as e-commerce, digital banking, telecommunication, healthcare, and agriculture. Access to local data can enable businesses to gain valuable insights, make informed decisions, and develop tailored products and services that cater to the specific needs of African consumers.

Statistics highlight the potential economic impact of local data governance and infrastructure development. According to a report by the World Economic Forum, enhancing data localization efforts in Africa could contribute up to US$300 billion to the continent's GDP by 2025.[138] This demonstrates the significant economic opportunities that can be harnessed through data sovereignty and the establishment of local data transfer and storage capabilities.

APET advises that prioritising data sovereignty and building local data infrastructure in Africa can lead to increased economic self-reliance, job creation, technological innovation, and improved competitiveness on the global stage. By fostering a conducive environment for data governance and investing in data infrastructure, African countries can unlock the full potential of their data resources and drive sustainable economic advancement across various sectors.

5.2 THE GOALS AND TARGETS

Pillar 2 is centred on the Data foundations, infrastructure, and use of Data to build sustainable AI solutions that contribute to national and continental economic growth in Africa. There is a need to analyse the existing data market, identify the gaps, and engage with data stakeholders to create a framework that will guide data engineers, data-driven products, data source providers, and governments from the academic, public, and private sectors. For this purpose, the report is focusing on highlighting data challenges in the African market, reviewing the Malabo convention, and the need to establish consistent frameworks and data policy to reduce biases, increase benefits from existing innovation, and stimulate the adoption of Artificial intelligence on the African continent.

The key points that raise concerns over these past years are the question of commitment from African Union Member States towards collaborative efforts. These are summarised as follows:

a) How can African countries collaborate to create a single data market?

b) How to leverage existing data sources and make data accessible for all?

c) How to support and promote local AI use cases to stimulate the African market to compete in the global market? The guiding philosophy behind such efforts should be that of nothing about us, without us: the AU Member States need to recognize that Africa is more than just a data source or service consumer. Balancing openness with the active engagement of Africans in all parts of the beneficiation is prime. Mixed licenses such as Free for Africans to use and pay for people out there could be considered.

d) How to encourage data and AI stakeholders to comply with the Malabo Convention's data protection framework? Full ratification and acceptance of the Malabo convention are expected from AU Member States. The current situation where only 16 states have signed and only 13 out of the 55 African countries have ratified the Convention as of 31st May 2022, is not encouraging.

[138] https://www3.weforum.org/docs/WEF_Friends_of_the_Africa_Continental_Free_Trade_Area_2023.pdf.

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5.3 CONTINENTAL FRAMEWORKS ON DATA FOUNDATIONS AND USE

Data is increasingly recognized as a strategic asset, integral to policymaking, private and public sector innovation, performance management, and creating new entrepreneurial opportunities for businesses and individuals.[139] However, the full value of data can only be realized if data is collected, manipulated, and used by certain universal principles as outlined by Data Principles.

In Africa, one of the key frameworks on data use and management is the African Union Data Policy Framework. The framework is guided by the broad principles of transparency, accountability of institutions and actors, the inclusion of stakeholders, equity among citizens, and fair competition amongst market players. The principles guiding the framework include trust, accessibility, interoperability, security, quality, integrity, representativity, and non-discrimination.

The implementation of the Data Policy Framework in Africa has wide-ranging impacts on various initiatives and instruments already in place. The framework draws on existing strategies and programmes, such as the Digital Transformation Strategy for Africa 2020-2030 (DTS), the African Continental Free Trade Area (AfCFTA), the Policy and Regulatory Initiative for Digital Africa (PRIDA), the Programme for Infrastructure Development in Africa (PIDA), and the Smart Africa Vision. By aligning with these initiatives, the Data Policy Framework amplifies their impact and reinforces their objectives. It strengthens the digital transformation agenda outlined in the DTS, supports the creation of a unified digital market under the AfCFTA, fosters a conducive policy and regulatory environment through PRIDA, promotes infrastructure development through PIDA, and accelerates the realization of the Smart Africa Vision to transform the continent into a single digital market by 2030. The Data Policy Framework's integration with these existing initiatives enhances their effectiveness and contributes to the overall advancement of Africa's digital landscape, economic growth, and sustainable development.[140]

The impact of digital policy in Africa is amplified through its integration with various initiatives and frameworks. These include the Free Movement of Persons (FMP), which facilitates the movement of individuals across the continent, and the Single African Air Transport Market (SAATM), which promotes seamless air travel within Africa. Additionally, the policy aligns with the Single Electricity Market in Africa, aiming to enhance energy access and connectivity. The Interoperability Framework on Digital ID ensures compatibility and efficiency in digital identification systems, while the African Union Convention on Cyber Security and Personal Data Protection (Malebo Convention) addresses crucial aspects of cybersecurity and data privacy. Moreover, the Declaration on Internet Governance and Development of Africa’s Digital Economy highlights the continent's commitment to advancing digital development.

By building on existing guidelines and frameworks, such as the Personal Data Protection Guidelines for Africa, regional model laws on data protection and cybersecurity, and the African Union Charter on Human and People's Rights, the digital policy establishes a comprehensive framework for promoting digital rights, data protection, and cybersecurity practices across Africa. These collective efforts foster an enabling environment for digital innovation, economic growth, and the advancement of Africa's digital economy.

5.4 MALABO CONVENTION: AFRICAN UNION CONVENTION ON CYBER SECURITY AND PERSONAL PROTECTION

The African Union Convention on Cyber Security and Personal Data Protection, also known as the Malabo Convention, is a legal framework adopted by the African Union in 2014 to address issues related to cybersecurity and personal data protection in Africa. The convention aims to promote the safe and secure use of information and communication technologies (ICTs) on the African continent, while also

[139] https://www.oecd.org/gov/budgeting/43412680.pdf.
[140] https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf.

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protecting the privacy and personal data of individuals. It covers a range of topics, including cybercrime prevention and prosecution, data protection and privacy, electronic transactions and online consumer protection, and the promotion of international cooperation in addressing cyber threats. It is expected to be an important tool for promoting digital security and economic growth in Africa.

The convention has been signed by 16 countries and ratified by only 13 African countries (by the time of this writing), as shown in Table 2. It encompasses varied aspects that can form a unified foundation for African countries to benefit from the information economy. It recognizes the importance of information and communication technologies (ICTs) for Africa's development and establishes a framework for African countries to develop and implement comprehensive cyber security strategies and policies. It seeks to address the increasing cyber security threats and challenges facing African countries. The Convention promotes international cooperation among African countries to combat cybercrime and other cyber security threats. It requires African countries to establish cyber security awareness and education programmes for their citizens.

Here is a summary, not exhaustive, of some key issues in personal data protection:

a) Lawfulness, fairness, and transparency: Personal data should be collected and processed lawfully, fairly, and in a transparent manner.

b) Purpose limitation: Personal data should be collected and processed for specified, explicit, and legitimate purposes.

c) Data minimization: Personal data should be adequate, relevant, and limited to what is necessary for the purposes for which it is processed.

d) Accuracy: Personal data should be accurate and, where necessary, kept up to date.

e) Security: Personal data should be processed in a manner that ensures appropriate security, including protection against unauthorized or unlawful processing and accidental loss, destruction, or damage.

Therefore, without ratification, Africa risks not having a unified view on the deployment of data tools. This is more exaggerated in some African countries that have relaxed or non-existent protections.

Table 2: List of countries that have signed, ratified/acceded to the African Union convention on cyber security and personal data protection[141]

	Country	Date of Signing	Date of Ratification
1	Angola	-	21/02/2020
2	Benin	28/01/2015	-
3	Cameroon	12/08/2021	-
4	Cape Verde	-	13/11/2020
5	Chad	14/06/2015	-
6	Comoros	29/01/2018	-
7	Congo	12/06/2015	24/09/2020
8	Gambia	02/12/2022	

[141] https://au.int/sites/default/files/treaties/29560-sl-AFRICAN_UNION_CONVENTION_ON_CYBER_SECURITY_AND_PERSONAL_DATA_PROTECTION_0.pdf [Date Accessed: March 01, 2023

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9	Ghana	04/07/2017	13/05/2019
10	Guinea-Bissau	31/01/2015	
11	Guinea		31/07/2018
12	Mozambique	29/06/2018	02/12/2019
13	Mauritania	26/02/2015	
14	Mauritius		06/03/2018
15	Namibia		25/01/2019
16	Niger		22/02/2022
17	Rwanda	16/04/2019	14/11/2019
18	Senegal		03/08/2016
19	Sierra Leone	29/01/2016	
20	Sao Tome & Principe	29/01/2016	
21	Togo	02/04/2019	30/09/2021
22	Tunisia	23/04/2019	
23	Zambia	29/01/2016	15/12/2020

Source:]

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5.5 IMPLEMENTATION PROGRESS OF POLICIES AND FRAMEWORKS

The AU has a precursor of policies and frameworks that require 13 African countries to be ratified. This is because a minimum of 16 countries should ratify these policies to implement. However, some African countries have changed local policies to implement digital protections but have not ratified them as yet. The responsibility is on large African countries such as Nigeria and South Africa to guide and support the process of implementation. As such, reports have estimated that 32 of AU's 55 Member States have enacted or at least embraced some form of the regulatory framework to protect personal data.

Regionally, legislative tools such as the 2008 East African Community Framework for Cyber Laws, the 2010 Supplementary Act on Personal Data Protection of the Economic Community of West African States (ECOWAS), and the 2013 Southern African Development Community model law are harmonizing the policies for the ICT Market in Africa. Continentally, the African Union developed the first pan-African framework with the African Union Convention on Cyber Security and Personal Data Protection (Malabo Convention) in 2014, which has not come into effect. However, this framework is currently being ratified. This is because data is being progressively recognized as a strategic and integral asset to policy making. This will influence the private and public sector innovation and performance management and create new entrepreneurial opportunities for businesses and individuals.

When applied to governmental services, emerging technologies such as AI technology can generate huge amounts of digital data economy. This can substantially contribute to socioeconomic development and growth because of the strategic policy perspectives that can balance multiple policy objectives. This can unleash socioeconomic data to the prevention of harm associated with the mass collection and processing of personal data. Thus, African countries can maximize the benefits of a data-driven

economy by generating an enabling policy environment for private-public investments that are necessary to establish data-driven value creation and innovation.[142]

5.6 REVIEW AND UPDATE OF POLICY FRAMEWORKS

The African Union provides a data policy framework that Member States can utilise as a model for developing their national frameworks. The policy aims to create a common approach to data management across the African continent and promote the use of data to drive inclusive and sustainable development. It emphasizes the importance of data as a critical resource for economic and social development and calls for the promotion of data sovereignty, data protection, and data sharing. The framework also encourages the use of data to drive evidence-based policymaking and decision-making and highlights the need for capacity building and institutional strengthening to support effective data management. There is also the African Union Convention on Cyber Security and Personal Data Protection, which is a legal framework adopted by the African Union in 2014 to address issues related to cybersecurity and personal data protection in Africa. These policies can provide a common template for African countries to implement unified legislation and policies that will encourage a synergetic information economy.

Over the past decade, many African countries have developed data privacy and security laws. According to Data Protection Africa, (at the time of this writing), 33 out of 55 Member States have developed and implemented data protection laws and 5 Member States are at the draft stage. While this is a step in the right direction, it is worth noting that only 16 Member States have signed the African Union Convention on Cyber Security and Personal Data Protection (known as the Malabo Convention). For optimal results, it would be ideal for Member States to sign and ratify the Data Protection policy and utilise it as a framework to develop their localized policies. This approach would ensure coherence and consistency across the continent, promoting synergies and alignment.

Data protection is one aspect of the data economy. There remains a need to create and implement enabling data policies that encourage AI innovation for African economies to reap benefits from data-driven economic activities.

5.7 DATA CHALLENGES

The African market represents a huge opportunity for technology companies to advance AI infrastructure due to the size and number of challenges requiring software solutions. However, Africa is not fully prepared to seize the enormous opportunities that AI presents. African Union Member States need to move with haste towards developing policies, strategies, and plans that would ensure growth and prosperity within the digital revolution space. The need to create products that meet demand requires the use of reliable African data. Therefore, it is important to analyse the issues of data accessibility, data collection, data storage, and the use of these data.

There is also an urgent need to establish data infrastructure on the continent. This would naturally include computing facilities such as data centres and cloud services, broadband coverage, and a stable green energy supply. Further to this, Africa should also overcome the challenge of capacity building. There is a need for a specialized human workforce to develop, deploy and utilise AI solutions across the continent. Furthermore, Africa needs to intensify data literacy among its societies.

5.7.1 CONTEXT

[142] https://au.int/sites/default/files/documents/42078-doc-AU-DATA-POLICY-FRAMEWORK-ENG1.pdf.

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To understand the challenges African organisations face in the process of collecting and using data, interviews were conducted with 30 people working as data scientists, researchers, policymakers, and entrepreneurs based in Africa. These experts have built different AI solutions for the African market. The data collected is subject to confidentiality terms and will be used in a storytelling format to highlight the data issues that most of them face. Worth noting, to ensure confidentiality, Health Solutions Lab is a fictional organisation name used to describe the company persona.

5.7.2 PERSONA DESCRIPTION:

Health Solutions Lab is an Africa-based laboratory that works with academic researchers, AI engineers, and medical industry experts to design and build medical solutions with the primary vision of improving the medical ecosystem in Africa. Since its official launch in 2016, The laboratory has invested US$500,000 in research and worked on three AI projects. The funds are from various sources including private donations and grants from American Non-Governmental Organisations. The team has successfully built a stroke detection system 'trained' on data generated via regular clinical proceedings and quantified from medical notes, some electronic healthcare device recordings, clinical laboratory studies, and many other sources non defined.

The technology developed is a machine-learning rapid analysis of suspected large vessel occlusion (LVO) strokes, which account for one in four acute ischemic strokes. Aside from stroke detection, the platform allows stroke specialists to synchronize data and communicate between neurologists to optimal patient treatment decisions, potentially saving critical minutes or even hours. During our interview with the chief of the Data Lab, she mentioned that the team has been facing a lot of data challenges that slowed down research in the laboratory and weaknesses in the accuracy and performance of their current AI models.

Like Health Solution Lab, there are several Africans who are investing in solving local problems in various industries but due to challenges related to data accessibility and cost associated with data storage and usage on the African continent, they are limited to leverage on their potential to tackle some of the modern challenges faced by Africans, leading to increase poverty and slow economic development in African countries.

5.7.3 DATA NEEDS

"Data needs" encompass the specific data requirements that individuals or organisations should accomplish their goals or objectives. When developing AI systems, it is essential for organisations to identify and articulate their data needs based on the specific context, industry, and intended use case(s). This ensures that the data collected and utilised aligns with the organisation's objectives and enables the creation of effective and impactful AI solutions. By clearly defining their data needs, organisations can enhance the relevance, quality, and applicability of the data used in their AI systems, leading to more accurate and valuable outcomes.

While Africa experiences a significant volume of data production and consumption, it is crucial to acknowledge that much of this data is unstructured and gathered from unreliable sources. As a result, many organisations in Africa struggle to define and identify the specific data required to develop effective solutions. Consequently, these companies often rely on available data, which carries a high risk of incorporating incorrect or biased information into their AI algorithms. This reliance on unreliable data sources can lead to the perpetuation of biases and inaccuracies in the outcomes generated by AI systems employed by African organisations.

The data needs faced by local organisations in Africa are primarily rooted in the lack of data digitalization within specific industries. For instance, in the healthcare sector, hospitals often handle

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vast amounts of complex personal data from patients but remain non-digitized or inadequately secured. This poses a significant challenge for AI companies as they face limitations in selecting reliable data sources to train and feed their AI models.

Furthermore, acquiring necessary datasets often involves cumbersome processes requiring credentials and authorizations, which entail paperwork and prolonged processing times. These additional administrative burdens come with associated costs that many local startup companies may struggle to afford, thereby, hindering their access to critical data resources.

In addition, certain AI models require substantial volumes of data to achieve optimal performance. Unfortunately, Africa faces limitations in terms of high-speed computational facilities, limited collaborations between researchers, and inadequate regulations surrounding data usage. These factors collectively impede local innovators from expanding their offerings and fully capitalising on the potential of AI technology.

Addressing these challenges requires concerted efforts to promote data digitalisation, enhance data security measures, streamline authorisation processes, reduce administrative burdens, and invest in high-speed computational infrastructure. By fostering collaborations and establishing effective data regulations, Africa can empower local organisations and innovators to overcome these barriers and unlock the full potential of AI-driven solutions in various industries.

5.7.4 DATA COLLECTION: INNOVATORS, RESEARCHERS, AND STAKEHOLDERS

Data collection plays a vital role in both research and the development of artificial intelligence. It involves gathering information from diverse sources to analyse, interpret, and utilise in decision-making processes. However, in Africa, many local organisations still rely on traditional data collection methods, such as paper-based questionnaires and physical interviews. These outdated approaches are inefficient, insecure, and time-consuming, resulting in incomplete, redundant, and ambiguous datasets. This poses a significant challenge for stakeholders in various industries who depend on such data.

To address this issue, there is a need for modernisation and adoption of more efficient and secure data collection methods, such as digital surveys, online interviews, and automated data capture systems. By embracing innovative data collection techniques, African organisations can improve the quality, reliability, and accessibility of their data, thereby enhancing decision-making processes and enabling more effective utilisation of artificial intelligence.

With the increasing adoption of mobile devices and a substantial rise in the number of internet users, which was estimated to be around 570 million in 2022.[143] As a result, several organisations have embraced contemporary data collection methods that offer enhanced efficiency and cost-effectiveness. Among these methods, mobile-based surveys have gained prominence, allowing for convenient data collection through mobile devices. Additionally, online surveys conducted through various digital platforms and social media channels have provided a broader reach and access to a diverse pool of respondents. Furthermore, the utilisation of advanced technologies such as GPS, satellites, sensors, and smart devices such as Electronic Medical Records (EMR) has revolutionized data collection processes, enabling more accurate and real-time data acquisition in areas such as healthcare. These modern data collection approaches demonstrate the potential for organisations to leverage technology to obtain reliable and comprehensive data for informed decision-making and AI development.

A critical analysis of the data collection process in Africa reveals significant challenges faced by key stakeholders in the region. One of the primary obstacles stems from the underdeveloped infrastructure prevalent in many African countries, which hinders effective data collection at the local level. For instance, the absence of a robust digital identity system in some African nations leads to reliance on

[143] https://www.statista.com/topics/9813/internet-usage-in-africa/.

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manual identification methods. This not only impedes the efficient collection of data but also restricts access to opportunities that should ideally be accessible to all individuals. The limited infrastructure in place poses a barrier to the seamless and secure gathering of data, thereby impacting the ability of organisations and policymakers to obtain comprehensive and accurate information for informed decision-making and equitable development. Addressing these infrastructure gaps and strengthening digital identity systems are crucial steps toward improving data collection capabilities and ensuring inclusive access to opportunities throughout Africa.

An in-depth analysis reveals several critical issues impacting the data collection landscape in Africa, supported by statistical analysis and real-world examples. Firstly, the lack of financial support and collaboration between universities in the academic sector hampers the motivation of researchers, resulting in limited data availability and contribution. For instance, some researchers are reluctant to openly share their data with other academic institutions, hindering collaboration and the potential for valuable insights and advancements. Furthermore, the trustworthiness of online open data sources is a concern for AI developers due to issues of transparency, accuracy, and data inconsistency. This lack of trust restricts the utilisation of certain data sources, reducing the options available for AI development.

The impact of these challenges is significant. Countries around the world that have successfully established robust data collection practices benefit from good infrastructure, reliable internet connectivity, a multitude of secure open data sources, and well-defined data collection policies. In contrast, many decision-makers in Africa fail to invest adequately in the African data market, leading to limited research centres, a scarcity of open data sources, and a shortage of expertise in data collection. Consequently, Africa faces difficulties in building and enhancing data collection processes, impeding progress in leveraging data for informed decision-making, policy development, and economic growth.

Therefore, addressing these challenges is crucial for Africa's development. By prioritizing financial support, fostering collaboration between universities, and promoting open data practices, researchers can be motivated to contribute and share their data, leading to increased data availability for AI innovation. Additionally, enhancing transparency and reliability in online open data sources and establishing clear data collection policies will encourage trust and expand data source options for AI developers. Such investments in the African data market and the improvement of data collection processes will unlock the potential for evidence-based decision-making, empower researchers, and drive sustainable development across the continent.

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5.7.5 DATA STORAGE

The concept of "Data Storage" encompasses the process of digitally recording and preserving information in various formats, such as documents, images, videos, and audio files, within a storage system for future utilisation. Data storage methods vary, with traditional on-premises servers, mobile devices, and cloud storage being the most used. Cloud storage, in particular, involves storing data remotely on servers operated by third-party providers. To ensure effectiveness, data storage systems should meet specific requirements, including accessibility, scalability, durability, compatibility, and compliance with national and international data security standards.

However, our market research has identified several gaps in data storage within African markets. Local private and public institutions often face resource limitations, hindering their ability to invest in robust data storage solutions and maintain effective systems. Furthermore, the lack of comprehensive data governance, inadequate local data centres, poor digital infrastructure, and data skills gaps contribute to a situation where many African businesses and organisations opt to host their data outside of their borders, thereby relinquishing a degree of African political, economic, and digital sovereignty.

The reliance on countries such as Ireland and the Netherlands in Europe to host data from multiple African nations has significant implications for the economic development of Africa. This trend signifies a loss of control and economic opportunities for African countries, as their data is stored and

managed outside of their borders. By outsourcing data storage to foreign countries, Africa faces challenges in terms of data sovereignty, security, and the ability to leverage data for local economic growth.

The statistics from Xalam Analytics, revealing that Africa accounts for less than 1% of the global data centre capacity despite its significant population share of approximately 17%, further highlight the magnitude of the issue. This imbalance puts Africa at a disadvantage, as it hampers the region's ability to harness the full potential of data-driven initiatives, stifles local innovation, and limits the economic benefits that can be derived from effective data management.

Moreover, the dependence on external data storage facilities comes with economic implications. African organisations and businesses often incur additional costs associated with hosting data abroad, including data transfer and maintenance expenses. These financial burdens can hinder the growth and competitiveness of local enterprises, diverting resources that could have been invested in domestic infrastructure and technological advancements.

To counteract these challenges, African countries need to prioritise the development of robust and secure data storage capabilities within the continent. By investing in local data centres and digital infrastructure, fostering data governance frameworks, and promoting data sovereignty, African nations can retain control over their data, stimulate local innovation, attract investments, and drive economic growth. Given these challenges, African countries should prioritise investment and establish standardised systems for data storage. By doing so, they can ensure the durability and longevity of stored data within the continent, fostering data sovereignty, and unlocking the full potential of data-driven initiatives for economic development and innovation.

5.7.6 DATA USAGE, DATA SHARING, AND ACCESSIBILITY

Understanding the African data ecosystem requires a closer examination of how data is accessed, used, and shared across the market. In many African countries, there are challenges related to the absence, incompleteness, and inaccuracy of data, which significantly impact economic development. Here are some specific examples to illustrate these challenges and their impact:

a) Agriculture: Agriculture is a vital sector in many African countries, but access to accurate and up-to-date data is crucial for effective planning and decision-making. For instance, farmers require data on weather patterns, soil conditions, market prices, and crop diseases to optimize their productivity. However, the lack of reliable data hampers their ability to make informed choices, leading to lower crop yields and reduced profitability.
b) Healthcare: Access to quality healthcare is a pressing issue in Africa. Data plays a critical role in addressing health challenges such as disease outbreaks, resource allocation, and monitoring public health indicators. However, incomplete, or inaccurate health data impedes effective policymaking and resource allocation. For example, without accurate data on disease prevalence or healthcare utilisation, governments may struggle to allocate resources efficiently, resulting in inadequate healthcare services and compromised public health outcomes.
c) Education: Data-driven decision-making is essential for improving educational systems. African countries face challenges in collecting comprehensive and accurate data on student enrolment, attendance, and performance. This lack of data hinders efforts to identify educational gaps, implement targeted interventions, and allocate resources effectively. Without reliable data, it is challenging to develop evidence-based policies that address specific educational needs, leading to lower educational outcomes and hindering economic development.
d) Financial Inclusion: Access to financial services is crucial for economic empowerment. However, many Africans lack access to formal banking and financial services. Data gaps make it difficult for financial institutions to assess creditworthiness and design appropriate financial products. Limited data on individuals' financial behaviours and credit history inhibit financial

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institutions from extending loans and other financial services to the underserved population, hindering economic growth and entrepreneurship.

The challenges in accessing, using, and sharing data in Africa also give rise to privacy concerns and economic disparities. Data privacy violations occur when institutions collect and use people's sensitive data without their consent. This further erodes trust in data systems and inhibits data sharing. Even when individuals and organisations agree to share data, there is a risk of misuse by third parties who may use the data differently than intended.

Additionally, the lack of restrictive national regulatory policies on data accessibility and sharing opens the door for non-African organisations to exploit African data without benefiting the economic growth of the continent. This can result in the extraction of valuable data without appropriate compensation or knowledge transfer, limiting the local capacity for innovation and economic development.

To address these challenges, it is crucial to prioritise data governance frameworks that emphasize data privacy, data accuracy, and data sovereignty. African governments and regulatory bodies should establish clear policies and regulations to protect individuals' data rights, ensure consent-based data sharing, and promote responsible data use. This will enable African countries to leverage their data assets for their economic development while safeguarding privacy and promoting equitable partnerships with external entities.

5.7.7 DATA INTEGRATION AND INTEROPERABILITY

Data integration and interoperability play a crucial role in socioeconomic development, enabling effective decision-making, improved service delivery, and enhanced collaboration among various sectors. However, in many African institutions, there is a limited understanding of the importance of data integration and interoperability, primarily due to the lack of a data-sharing culture.

Here are some specific examples to demonstrate the impact of these challenges on socioeconomic development:

a) Public Service Delivery: Efficient public service delivery relies on the ability to integrate data from different government departments and agencies. For instance, to provide effective healthcare services, it is essential to integrate data from health facilities, patient records, pharmaceutical supplies, and disease surveillance systems. Without data integration, it becomes difficult to identify healthcare trends, allocate resources effectively, and respond to public health emergencies. As a result, the quality of public services, including healthcare, education, and social welfare, may suffer, affecting socioeconomic development.
b) Business and Trade: Data integration and interoperability are crucial for supporting business activities and fostering trade within and across African countries. For instance, customs and trade agencies need to exchange data seamlessly to facilitate cross-border trade and ensure compliance with regulations. In the absence of interoperable systems, businesses face delays, increased costs, and administrative burdens. This hampers economic growth, discourages foreign investment, and limits the potential for regional integration and trade.
c) Infrastructure Development: Data integration is vital in the planning and implementation of infrastructure projects such as transportation, energy, and telecommunications. For example, in the transportation sector, integrating data from traffic management systems, public transport networks, and urban planning can optimize infrastructure investments, reduce congestion, and enhance transportation efficiency. However, the lack of interoperable data systems hinders comprehensive planning and coordination, leading to suboptimal infrastructure development, increased costs, and limited socioeconomic benefits.
d) Agricultural Productivity: Agriculture is a key sector for many African countries, and data integration is critical for improving agricultural productivity. By integrating data from weather forecasts, soil conditions, market prices, and farmer profiles, stakeholders can make informed

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decisions on crop selection, resource allocation, and market access. However, without interoperable systems, valuable agricultural data remains fragmented, hindering the adoption of precision agriculture techniques and reducing overall productivity and competitiveness.

To address these challenges, African countries should prioritise the development of necessary data infrastructures, including robust data governance frameworks, reliable network connectivity, and technical monitoring solutions. Governments should play an active role in regulating data exchange and promoting data standardization across the continent. It is essential for governments, data consumers, data processors, and other stakeholders to collectively establish a common understanding and adhere to a shared data framework that facilitates data sharing and integration across systems located in different countries. This will foster collaboration, drive innovation, and unlock the socioeconomic value of data for the benefit of African societies as a whole.

5.8 ENCOURAGING PROGRESS IN INVESTMENT AND ACCRUING BENEFITS FROM DATA IN AFRICA

The market study on data in Africa has identified several challenges and gaps that require attention from governments, private sectors, and public sectors to foster social and economic development. It is crucial to acknowledge these challenges and work collaboratively to address them.

Africa presents an attractive investment destination in the data market, primarily due to its demographic advantage. With a projected population of 2.5 billion people by 2050, Africa offers a significant consumer base for data-related services. This population growth also fuels the expansion of Africa's broadband user base, driving the demand for seamless and secure data exchange, transfer, storage, and access. Recognising the potential of Africa's data market and addressing the identified challenges will contribute to unlocking the immense social and economic opportunities the continent offers.

Considering the emergence of technologies and innovation in the world, African countries should align with the trends of exploring AI with its potential to overcome practical limitations of capital and labour by opening a new source of value. Indeed, stimulating the use and management of data by local entities can be used to address existing challenges and future deficits on the continent.

It is important to acknowledge that contemporary software service providers, including start-up companies, SMEs, and corporate entities, heavily depend on digital ecosystems and effective data utilisation to meet market demands with precision. Certain African countries have made significant strides both domestically and internationally in their endeavours to contribute to the global market value of data while also ensuring data sovereignty within Africa.

For instance, African countries such as Kenya have experienced substantial growth in their digital entrepreneurship sector, with start-up companies offering innovative software services tailored to various industries such as finance, agriculture, and healthcare. These start-up companies leverage data analytics and integration to deliver accurate and targeted solutions, enhancing efficiency and competitiveness in the market. This not only contributes to the overall economic development of the country but also strengthens its position in the global data market.

Similarly, Rwanda has made notable advancements in establishing itself as a data-driven nation. The country has implemented initiatives to enhance data management, promote data sharing, and foster a culture of innovation. Through collaborations with international organisations and partnerships with local entities, Rwanda has developed robust data infrastructures, including data centres and digital platforms. These efforts have attracted global investments and positioned Rwanda as a hub for data-related services, creating employment opportunities and driving socioeconomic growth.

By actively participating in the data global market, African countries can increase their economic competitiveness, attract foreign investments, and create local job opportunities. Moreover, ensuring data sovereignty in Africa is crucial for safeguarding the interests and privacy of African citizens, as

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well as leveraging data assets to address local challenges and foster sustainable development. The progress made by African countries in these areas signifies their commitment to harnessing the potential of data and emerging as key players in the global digital economy.

The South African government developed an AI strategy and roadmap, which was published in April 2020. The strategy aims to position South Africa as a leader in AI research and innovation. On the continent, South Africa has been recorded to hold the largest market share for data centres due to the country's digital economy which contributes 6 % to its today's GDP of over US$315 Billion. South Africa ranks 25th globally on Cloudscene based on data centre density. Internet Solutions, Liquid Telecom, and MTN are the country's top service providers. The connectivity ecosystem in South Africa is composed of 52 colocation data centres, 335 cloud service providers, and six network fabrics, with 52 internet users per 100 people.[144]

Nigeria has established itself as a prominent market for data centres, boasting a population of over 182 million and a GDP of US$482 billion. The country hosts several data centres and server farms, including those operated by leading companies like MainOne, Netcom, and Rack Centre. These service providers play a pivotal role in meeting the data storage and processing needs of businesses and organisations in Nigeria.

Kenya is an emerging market for data centres, with a growing number of internet users, currently standing at 46 per 100 people. The country features ten colocation data centres, 23 cloud service providers, and two network fabrics within its connectivity ecosystem. Notable service providers in Kenya include Safaricom and Liquid Telecom, which contribute to the development of the data infrastructure and support the digital transformation efforts in the country.

Egypt and Morocco are witnessing the growth of their digital economies and have seen the establishment of several data centres and server farms. In Egypt, companies like Raya Data Centre and NxtGen operate data centres, contributing to the country's digital ecosystem. Currently, Egypt boasts 14 colocation data centres spread across four different areas. Meanwhile, Morocco hosts data centres operated by telecommunications companies such as Maroc Telecom and Inwi, bolstering the country's digital infrastructure and supporting data-intensive services.

The presence of these data centres and service providers in Nigeria, Kenya, Egypt, and Morocco signifies the growing importance of data-driven technologies and digital services in these countries. These data centres not only support local businesses but also attract investments, foster innovation, and contribute to the overall development of the digital economies in these regions.

In November 2019, Rwanda launched its national AI policy, which aims to promote the development and adoption of AI in various sectors, including healthcare, education, agriculture, and industry. Rwanda is one country that is walking the talk and is among the few African countries that are leading the AI uptake race in Africa. In 2022, Rwanda established a Centre for the Fourth Industrial Revolution (CFIR), devoted to the advancement of artificial intelligence to facilitate the implementation of emerging technologies by the government more efficiently and flexibly. The centre is part of the World Economic Forum's network of centres that aims to promote the development of artificial intelligence. Africa Data Centres, a business of Cassava Technologies, a pan-African technology group, is building its first data centre in Kigali, Rwanda. The data centre, which is expected to be commissioned in the first quarter of 2023, is projected to have 2MW of IT load and is poised to meet the growing demand in the region.

5.9 CONSIDERATIONS ON DATA INFRASTRUCTURE IN AFRICA

[144] https://liquid.tech/about-us/news/Internet_Solutions_and_Liquid_Intelligent_Technologies_partner_on_wholesale_5G_services_for_enterprise_businesses/.

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The concentration of African data in offshore locations, such as Marseille in France, has substantial implications for the economic advancement of Africa. Currently, a significant portion of African data, up to 80%, is domiciled offshore, limiting the ability of operators in Africa to offer premium data transfer speeds and control over their data infrastructure. This dependence on foreign gateways not only hampers data-driven industries within Africa but also poses challenges to data sovereignty and economic development.[145]

For example, to illustrate the impact, considerations should be on the limited control over African data stored offshore which can result in slower data transfer speeds. Consequently, this can limit and impede the performance and competitiveness of African businesses in the digital landscape.[146] For instance, e-commerce platforms, online services, and cloud-based applications may experience latency issues and slower response times, leading to decreased user satisfaction and potential loss of customers. This, in turn, can hinder the growth of digital businesses and impede economic progress.[147]

Furthermore, the concentration of African data offshore can create dependencies on foreign providers and infrastructure, resulting in substantial capital outflows from the continent. African businesses may need to pay significant fees for data transfers and storage, which can be a drain on their financial resources and hinder local investment and job creation. The lack of local data infrastructure also limits the development of data-centric industries and innovation within Africa, preventing the continent from fully harnessing the economic potential of its data resources.[148]

To address these challenges, African countries are increasingly recognising the importance of data sovereignty and local data governance. Efforts are being made to establish laws and regulations that promote local data storage and transfer, encouraging the development of robust data infrastructure within the continent. For example, countries such as Nigeria have implemented data protection regulations that require certain types of data to be stored within the country's borders.[149]

By taking control of their data and building local data infrastructure, African countries can stimulate economic growth and advancement. This includes developing data centres, investing in high-speed internet connectivity, and fostering digital innovation hubs. These initiatives create opportunities for local businesses to thrive, attract foreign investments, and enable the development of data-driven sectors such as fintech, e-commerce, health tech, and agriculture.

Therefore, APET observes that the concentration of African data in offshore locations presents challenges to economic advancement. However, by prioritising data sovereignty, promoting local data governance, and investing in robust data infrastructure, African countries can unlock economic opportunities, drive innovation, and establish a thriving digital ecosystem that contributes to sustainable growth and development across the continent. As such, the considerations on data infrastructure in Africa include security, data protection, data ethics, and infrastructure for AI data, and these were summarised as follows:

5.9.1 SECURITY

The main consideration is that security goes hand in hand with data. The automated decision-making is made possible by AI. Therefore, there is a need to develop and implement protective policy frameworks, while enabling innovation. Remarkably, best practices to minimize the vulnerability of sensitive data such as the anonymization of all datasets used in algorithms distributed ledgers, and multifaceted cyber-security systems. This includes encryption during storage and transmission, proper destruction of identifying information, data facility security, and targeted investment in IT infrastructure.

[145] https://www.mainone.net/wp-content/uploads/2021/10/Data_Centres_in_Africa_Report_by_Oxford_Business_Group.pdf.
[146] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/2018AEO/African_Economic_Outlook_2018_-_EN_Chapter3.pdf.
[147] https://www.bis.org/publ/bppdf/bispap117.pdf.
[148] https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Apr/IRENA_RES4Africa_UNECA_Prosperous_Sustainable_Africa_2022_.pdf?rev=aed74ce1cd6f49269d8c3bbdf466ceb4.
[149] https://cseaafrica.org/wp-content/uploads/2021/08/Strengthening-Regional-Data-Governance-in-Africa-1.pdf.

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5.9.2 DATA PROTECTION

The main consideration of data protection is that Africa should protect data in all its forms and also expand its data protection mechanisms to AI models. Data protection is an important aspect of data governance across the world. As the information economy grows, so is the need to make sure that society is protected from any potential harm. From a security perspective, Africa should protect against theft of data including identity theft. There should also be protection against the misuse of data, especially without the knowledge of those that the data represents. Ultimately data should be treated with the sensitivity that it deserves.

Article 13 of the African Union Convention on Cyber Security and Personal Data Protection[150] covers these 6 principles, summarised as follows:

1. Principle of consent and legitimacy of personal data processing.
2. Principle of lawfulness and fairness of personal data processing.
3. Principle of purpose, relevance, and storage of processed personal data.
4. Principle of the accuracy of personal data.
5. Principle of transparency of personal data processing.
6. Principle of confidentiality and security of personal data processing.[151]

Ultimately principle number 6, exists protection of the data after principles 1-5 have been met. For AI research, development, and applications, African countries should have a wider understanding of how data interacts with AI systems and ways security incidents can have far-reaching consequences.[152] African countries should also understand how flawed data about people can be used to make decisions about people that are ultimately negative. Further to this, bad actors could compromise data to create AI models that are dangerous when destroyed since AI models learn from data as input.[153] Because of this, even if the data is not directly stored with the models, bad actors could compromise models that leak information about individuals. Therefore, to address these challenges, African countries should promote AI model transparency and fairness, enhance decision-making processes with model threats, and mitigate model data leakage.

5.9.3 DATA ETHICS

The primary focus of data ethics encompasses the creation, deployment, and use of data should be regulated. Multiple vectors of data could cause harm, and these are summarised as follows:

a) Finding the right balance between the right to privacy, technological innovation, and governance at the country level but also in the context of cross-border data flows.

b) Develop risk assessments to address ethical issues linked to data at all stages: Data collection, data preparation, model development, and deployment.

c) Transparency on algorithms.[154]

[150] AFRICAN UNION CONVENTION ON CYBER SECURITY AND PERSONAL DATA PROTECTION - https://www.opennetafrica.org/?wpfb_dl=4.
[151] Personal Data Protection Guidelines for Africa https://www.internetsociety.org/wp-content/uploads/2018/05/AUCPrivacyGuidelines_2018508_EN.pdf
[152] ASILOMAR AI PRINCIPLES https://futureoflife.org/2017/08/11/ai-principles/
[153] How to improve cybersecurity for AI https://www.brookings.edu/research/how-to-improve-cybersecurity-for-artificial-intelligence/
[154] https://researchictafrica.net/wp/wp-content/uploads/2020/11/RANITP2019-2-AI-Ethics.pdf.

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d) Political commitment and a strong formulation of the value proposition of data at the policy level to generate public interest in AI technologies, particularly in sub-Saharan Africa, where interest within policy circles is still in embryonic stages.

e) Application of universal human values and international standards that consider Africa's historical peculiarities, while achieving development objectives. This includes treating social, economic, and cultural rights on par with civil and political rights.

f) Organisations should have XAI as a key requirement to build responsible AI.[155]

NOTE: Explainable AI (XAI) is a set of processes and methods that allows human users to comprehend and trust the results and output created by machine learning algorithms. Explainable AI is used to describe an AI model, its expected impact, and potential biases.[156] It helps characterize model accuracy, fairness, transparency, and outcomes in AI-powered decision-making. Explainable AI is crucial for an organisation in building trust and confidence when putting AI models into production. AI explainability also helps an organisation adopt a responsible approach to AI development.[157]

Explainable AI helps users understand and interpret predictions, reducing the complexity, and allowing for non-technically trained practitioners and stakeholders to be more aware of the modelling process. At its core, XAI aims to deconstruct black-box decision-making processes in AI. Explainable AI can answer questions like "Why was this prediction made?" or "How much confidence do I have in this prediction?" or "Why did this system fail?"

5.9.4 INFRASTRUCTURE FOR AI DATA

To enhance AI data management, African countries should expand infrastructure for AI data for the public, private and academic sectors. To shape AI, African countries should be able to handle the computing and storage needs of the algorithms that will be deployed. To do these African countries should pursue a scalable and massive infrastructure of AI Data. The AI infrastructure should influence public and governmental services, private activities, and academic research.

In terms of cloud computing, for example, the cloud in Africa is undergoing massive transformation and acceleration. There has been a huge uptake in cloud services, especially when it comes to SMEs turning towards hyper-scalers. Meanwhile, more prominent organisations and governments have been embracing the private cloud. The private cloud that is in Africa includes:

a) Teraco[158]

b) Microsoft has availability on the African continent.

c) Google does not have availability on the African continent.[159]

d) Use cases of existing data centres in Africa.

[155] https://africa.ai4d.ai/project/developing-responsible-artificial-intelligence-in-africa-policy-centre-ii/.
[156] https://en.unesco.org/artificial-intelligence/ethics.
[157] https://africanaiethics.com.
[158] https://www.teraco.co.za/data-centre-locations/.
[159] https://cloud.google.com/about/locations.

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Figure 4. Google Cloud provides a private, software-defined network that provides fast and reliable connections to users around the world[160]

The development of colocation data centres in Africa has seen significant growth in recent years, highlighting the increasing demand for digital infrastructure on the continent. However, it is important to note that the distribution of these crucial facilities is unevenly spread across Africa, with certain regions lagging in terms of capacity and availability.

South Africa stands out as a prominent player in the African data centre market, accounting for more than two-thirds of the continent's total capacity. The country has invested heavily in establishing robust data centre infrastructure, attracting both local and international businesses. This has positioned South Africa as a hub for data storage and processing, benefiting from its favourable business environment and reliable power supply.

In contrast, West Africa currently contributes less than 10% of the total African data centre capacity. This region, which encompasses countries such as Nigeria, Ghana, and Senegal, faces challenges related to limited investment, inadequate infrastructure, and regulatory complexities. As a result, businesses in West Africa often rely on data centres located outside the region to meet their hosting and content delivery needs.

Furthermore, a significant portion of the data content consumed in Africa is hosted outside the continent. This means that African users accessing online services, social media platforms, and streaming content often experience latency issues due to the physical distance between their location and the data centres hosting the content. This situation not only leads to slower data transfer speeds but also hinders the growth of local data centre markets and the development of digital economies within Africa.

The African data centre market remains underserved, with a noticeable concentration of capacity in South Africa while other regions struggle to catch up. Bridging this gap requires increased investment in data centre infrastructure across the continent, particularly in regions with untapped potential. By fostering the development of reliable and efficient data centres in various African countries, the continent can improve its digital connectivity, enhance local content hosting capabilities, and encourage economic growth in the digital sector.

[160] https://cloud.google.com/about/locations.

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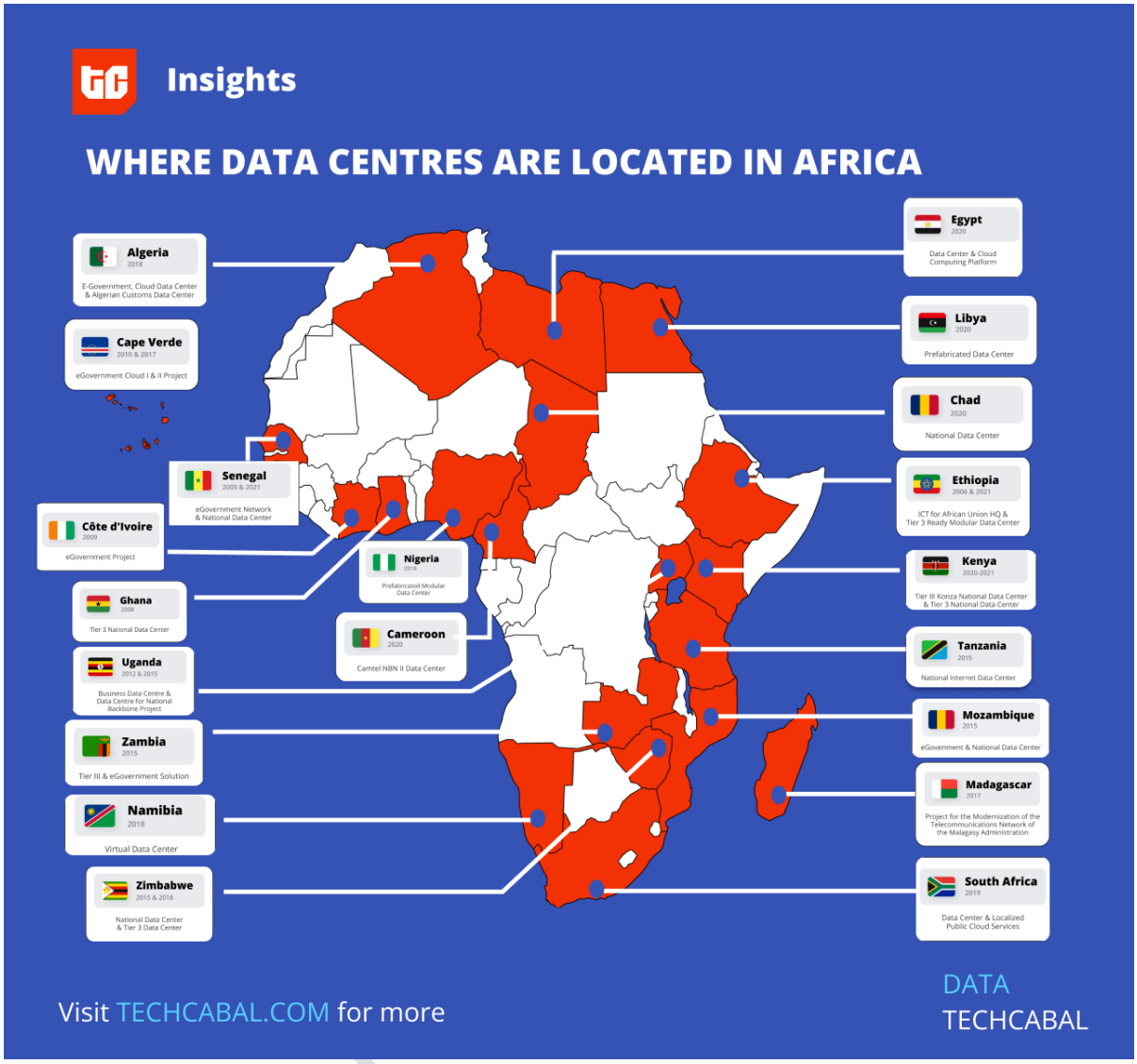

Figure 5. Data Centres locations in Africa[161]

A closer look at Africa's international digital connectivity traffic pattern indicates that; more than 80% of our international broadband and internet capacity traffic is directed towards other parts of the World. Also, the 2021 Africa Data Centre Association Market report shows that Africa accounts for less than 1% of the Multi-Tenant Data Centre capacity globally. This means that a greater percentage of the digital services consumed in Africa are hosted outside the continent. The economic implication of this pattern is immense and also includes the fact that the citizens of Africa will have to pay higher tariffs for internet and broadband services due to the long-distance international interconnection to digital services hosted outside Africa. Africa shall not reap the full benefits associated with all the future digital economies if Africa does not have enough multi-tenant data centre capacity and cloud infrastructure within the continent to support its digital transformation agenda. It is important to acknowledge the fact that some efforts are ongoing by stakeholders across the continent to improve the situation. These stakeholders include private sector organisations such as members of the Africa Data Centre Association, Multilateral Organisations and Developmental partners, the Investment Community, and some African Governments.

It is worth noting that some countries within the continent are emerging as the hub for Data Centres and Cloud services in Africa. These hubs include South Africa in the southern sector; Kenya in the eastern side; Nigeria and Ghana in the western side; Egypt, Algeria, and Morocco in the northern part of the

[161] https://techcabal.com/2022/10/03/data-centre-africa/.

continent. We have all witnessed some of the Global hyper scalers moving towards these hubs and that is encouraging.

This inflexion point in terms of establishing data centres is being partly driven by advances in connectivity and data consumption, particularly as smartphone penetration rises in Africa. The Middle East and Africa is projected to be the fastest-growing region in terms of internet user numbers in the years ahead. The region will also lead to the growth of devices and connections per capita.[162]

It is, nevertheless, noted that data centres are underutilised. Countries are encouraged to monitor the rate of utilisation of these data centres. A data centre needs substantial investment. It is therefore only proper that such facilities are optimally utilised. Therefore, African countries should make proper consideration their needs for a data centre. In some cases, a collaboration between nations would be a more viable approach to acquiring and utilising such facilities.[163]

The benefits of successfully running a data centre are far-reaching. First is increased top-line revenue for infrastructure providers. But even more than that, a robust data centre and fibre connectivity network across the continent also means better access to cheap internet, stronger trade ties, a deep and wider digital inclusion net, and the opportunity to have realistic conversations about data sovereignty, residency, and privacy regulation.[164]

The Africa data centre market witnessed investments of US$ 2.6 billion in 2021 and will witness investments of US$ 5.4 billion by 2027, growing at a CAGR of 12.73% during 2022-2027. The data centre market in Africa has attracted significant investments in recent years, led by South Africa, Kenya, Egypt, Nigeria, and Ethiopia. In Africa, there are more than 9 data centres that have added a white floor area of around 30,000 square feet area or more each in 2021. Several country governments are taking initiatives by developing special economic zones, and industrial parks, which provide tax exemptions for data centre development.[165]

Cloud adoption is likely to grow up to 25% annually in South Africa and is expected to generate up to US$ 1.5 billion by 2024. SaaS is being widely adopted among organisations in South Africa, followed by IaaS solutions in the country's data centre and networking market. In September 2021, Eskom, a utility firm based in South Africa, announced to invest around US$ 7 billion for renewable energy plans for the next nine years. This will drive the demand in the South African data centre market. The increase in submarine cable investment and fibre connectivity is likely to attract more data centre investments in the region. South Africa has the highest number of submarine cable deployments, followed by Nigeria and Kenya. So, despite the challenges, encouraging progress is taking place on the continent.

5.9.5 DATA SOVEREIGNTY

Africa should have oversight of citizens' data and automated decisions that affect Africa's citizens. Furthermore, AI regulators should have the capacity and skills to effectively regulate AI and data use. The best way to manage data sovereignty, African countries should increasingly ensure that data is located within the African continent.[166]

5.10 AI INFRASTRUCTURE NEEDS

[162] Afrika's digital future requires data centres https://www.iafrikan.com/afrikas-digital-future-requires-data-centres/.
[163] Microsoft opens first data centres in Africa with the general availability of Microsoft Azure https://azure.microsoft.com/en-us/blog/microsoft-opens-first-datacentres-in-africa-with-general-availability-of-microsoft-azure/.
[164] African Open Science Platform: Strategy and Vision https://codata.org/initiatives/decadal-programme2/global-open-science-cloud/African-open-science/.
[165] Digital Earth Africa to deliver robust data infrastructure for the continent https://www.uneca.org/stories/digital-earth-africa-to-deliver-robust-data-infrastructure-for-the-continent.
[166] The Era of Borderless Data Is Ending - https://www.nytimes.com/2022/05/23/technology/data-privacy-laws.html.

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African countries should meaningfully harvest the dividend of AI and other emerging technologies. However, AU Member States should build on their commitment to the Malabo Convention on critical cyber and ICT infrastructure. Furthermore, the AU Member States need to invest purposefully in building infrastructure for the development and deployment of AI systems and solutions. Africa needs to build capacity in high-performance computing systems, data storage systems, and fast connectivity. More importantly, AU Member States need to cooperate and partner to share resources since partnership will assist in optimising the usage of the resources.

5.10.1 ICT AND INTERNET

AU Member States need to make a deliberate effort to invest in enabling ICT and broadband internet connectivity, and access thereof, to enable the successful development and utilisation of local AI solutions. Markedly, over the past few years, internet access in Africa has grown exponentially. This was spurred by mobile internet which is at 28% connectivity as reported by GSMA (2021) on the state of mobile internet connectivity. However, this connectivity is not necessarily broadband although the deployment of international submarine cables has led to significant increases in the bandwidth capacity at an international level. But the territorial national backbone networks in Africa remain inadequate, despite the attempt by African governments to build these capabilities.

The private sector has also invested in broadband backbone infrastructure. Nonetheless, this is concentrated in urban areas and centres of economic activity and barely covers rural areas. Furthermore, policy and regulatory challenges have hampered investment in the expansion of networks to rural and under-serviced areas. Consequently, most African countries are yet to roll out the 5G networks, apart from Togo, Kenya, Madagascar, Seychelles, and South Africa. On wired access, only a few areas in most African countries have high-speed fibre-based connectivity and coverage. Most parts of the African continent, particularly in the Sub-Saharan region, are still lagging at 19% of basic connectivity. Additionally, even though internet connectivity is steadily improving, the cost of access is still high and unaffordable to many people in the region. Thus, AU Member States deliberately prioritise and invest in enabling ICT and broadband internet connectivity, and access thereof. Such efforts will enable the successful development and utilisation of local AI solutions. This is vital because successful AI requires fast connection speed and broadband within and among computer facilities.

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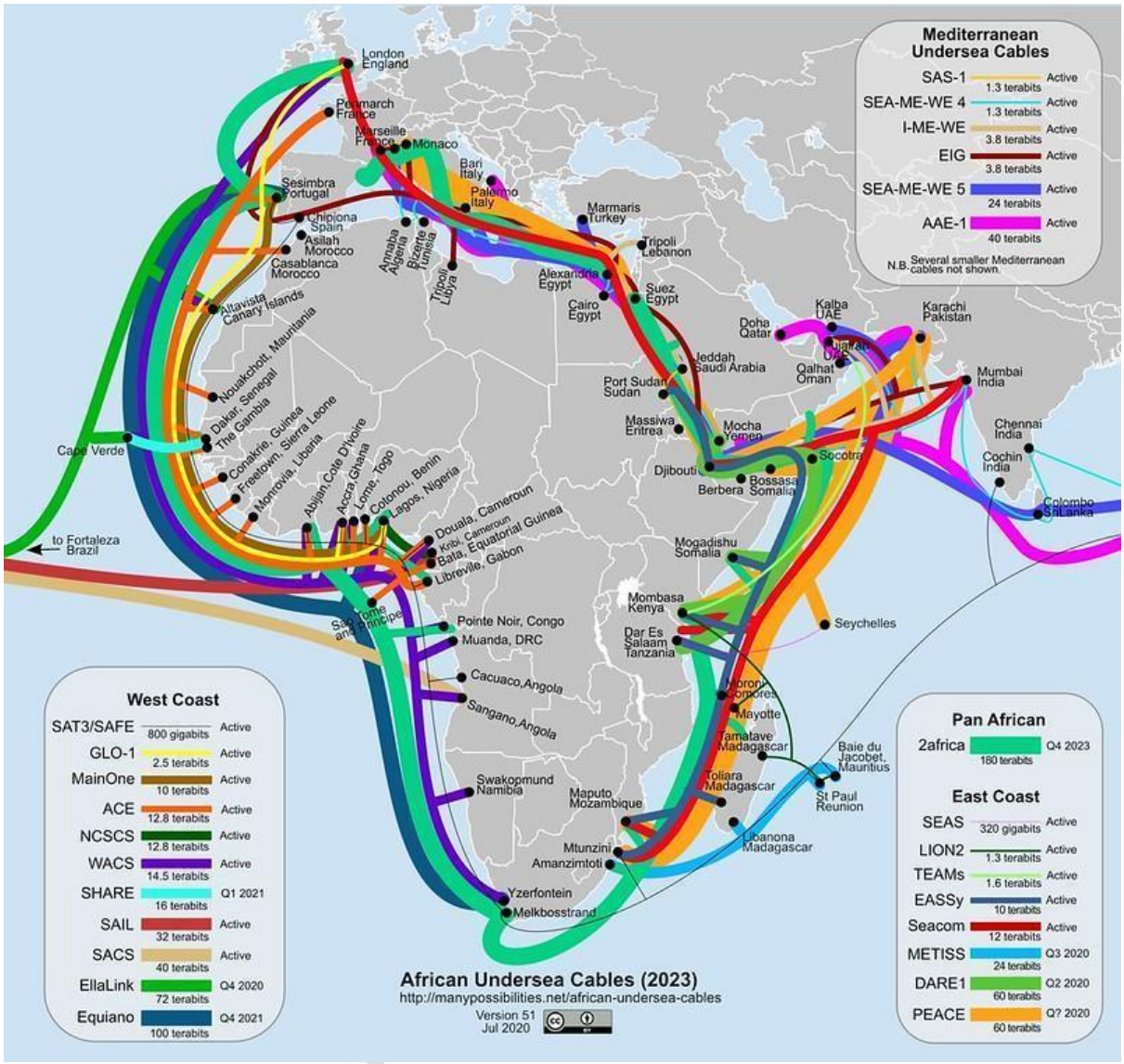

Figure 6. African Undersea cabling infrastructure[167]

5.10.2 COMPUTES

Africa should have at least one supercomputer within the top 50 tier as a continental referral facility for front-end computing. Furthermore, Africa needs to revolutionize its systems from Central Processing Unit-based to Graphical Processing Unit-based to accelerate their performance. Currently, individual regional economic communities (RECs) and nations are making progress in building capacity in necessary ICT infrastructures for AI. For example, in terms of supercomputing, the Southern African Development Community (SADC) is utilizing the South African Centre for High-Performance Computing (CHPC). The CHPC is leading the way in capacitating SADC Member States in high-performance computing (HPC). As such, the CHPC has provided training and computational clusters to Botswana, Madagascar, Namibia, Zambia, Ghana, Mozambique, Kenya, Mauritius, and now Malawi.

Other African countries with supercomputing facilities include Morocco at Mohammed VI Polytechnic University. The supercomputer contains more than 69,000 central processing units or cores (information processing units), more than 8,000 terabytes of storage, and more than 1,300 servers for its networking

[167] https://www.submarinenetworks.com/en/africa [acessed March 10, 2023]

capabilities. This supercomputer is ranked 98th on the world's Top 500 list of supercomputers and is the first most powerful supercomputer in Africa. On the other hand, Rwanda has a supercomputing facility at the African Centre of Excellence in Data Science.

Further to this, there are also multinational company-controlled AI Laboratories in Africa. These isolated systems are way behind compared to FUGAKU, the world's leading system with 7, 630, 848 cores, and other top systems in the world. These facilities are also faced with challenges relating to a lack of fast connectivity and stable power supply. Thus, AU Member States should build on these efforts and collaborate at regional or continental levels. This can help African countries scale up these AI systems to world-class. In addition, Africa needs at least one system in the top 50 by 2030. This can help Africa revolutionize the continent's systems from Central Processing Unit-Based systems to Graphical Processing Unit-Based systems to accelerate their performance.

For storage-intensive applications, Africa needs to host more of its clouds. Cloud computing falls within the broader ICT ecosystem as it relies on broadband internet connectivity. Broadband infrastructure development in Africa is uneven. While there has been significant growth in international bandwidth capacity and a decline in costs through the landing of several international submarine cables, terrestrial fibre backbone infrastructure remains inadequate, as does last-mile connectivity. Therefore, AU Member States should overcome these challenges by developing high throughput systems such as clouds. Progressively, Africa should move towards convergence of HPC and HTC systems.

5.10.3 ASSEMBLING PLANTS

For Africa to successfully deploy some AI solutions in other forms than software, particularly those from reinforcement learning, African countries need standard engineering workshops and assembly plants. Through these facilities, AI solutions, such as robots, can be embodied right here in Africa. Beyond individual country efforts, Member States are encouraged to form clusters, be it at the regional economic community level to substantially boost investments in these infrastructures. Public-private partnerships, particularly with major well-established companies, should also be considered and exploited.

5.10.4 SATELLITES

Africa should invest in satellite platforms for the ubiquitous deployment of AI solutions in various economic sectors. According to Constancy Space in Africa, 13 African countries have launched satellites into orbit. Egypt is leading the way with nine (9) launched satellites, followed by South Africa with eight (8), Algeria with seven (7), Nigeria with six (6), and Morocco with three (3). Other countries include Ghana, Sudan, Ethiopia, Angola, Kenya, Rwanda, and Mauritius.

Africa needs these satellite platforms for the ubiquitous deployment of AI solutions in application sectors such as Agriculture, forestry, climate monitoring, and water management. Close measuring of crop health, monitoring of drought, and tracking of tree coverage for more sustainable forest management are among the immediate benefits of such investments.

5.11 CASE STUDIES: DATA COLLECTION FOR AI APPLICATIONS

5.11.1 LACUNA FUND

Eyes on the Ground Image data for Agriculture: This project created a large machine learning dataset for crop phenology monitoring of smallholder farmer's fields. This is a unique dataset of georeferenced

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and timestamped crop images, which were captured using smartphone cameras following a standardised "picture-based insurance" protocol. This is accomplished along with labels on input use, crop management, crop growth stages, crop damage, and yield estimates, and collected across eight counties in Kenya.

Machine Translation Benchmark Dataset for Languages in the Horn of Africa: This project developed an evaluation dataset that automatically quantifies the quality of machine translation systems for Afar, Amharic, Oromo, Somali, and Tigrinya. This multi-way parallel corpus serves as a benchmark to accelerate progress in machine translation research and production systems for these five African languages.

5.11.2 AI4D: LANGUAGE

WOLOF ASR Data for Urban Transport: In a country such as Senegal, where about 50% of the population is reported to speak only local languages and cannot particularly read, technologies and applications that are designed to be used by people who can read are not as effective as they could be. In this project, the aim was to build an Automatic Speech Recognition (ASR) dataset and system in the Wolof language to help people with literacy challenges to interact with applications with just their voice, in a language they can already speak. The project is focusing on a public transport use case for two reasons. First, many users of public transport cannot read or speak French. So, these public transport services cannot interact effectively with the existing applications that help passengers to find a bus to a given destination. There is already an existing application in Senegal, WeeGo, which helps passengers to get transport information.

Luganda Agricultural Keyword Spotter: In Uganda, radio programmes are a critical mode for sharing information and reaching out to rural communities. Farmers throughout Uganda, and across Africa, rely on radio programmes in their local languages to learn more about agricultural practices and to obtain important market information. While these radios are extremely valuable to their target listeners, predominantly agriculturalists, the content of these programmes can also be important for other stakeholders such as researchers, government, and other decision-makers. This is because these radio programmes are providing an important source of information on the state of the agricultural sector.

However, the value to these other actors can be limited by the fact that this type of data is not easily monitored or analysed, as the data is unstructured, often in local languages, and of varying sound quality. The objective of this dataset and solution is to build a machine-learning model to identify the agricultural keywords, which may be in English or Luganda, spoken in an audio clip. The keywords relate to crops, diseases, fertilizers, herbicides, or other general agricultural topics.[168] Consequently, these datasets and modelling solutions have helped researchers from Makerere University. These researchers are developing a speech recognition model to automate the process of monitoring Luganda radio programmes for agriculture-related information. This solution will enable more efficient monitoring and analysis of local language radio programmes.

5.11.3 DISEASE OUTBREAK DETECTION USING AI IN RWANDA

In Rwanda, the Ministry of Health partnered with a technology company to develop an AI-powered system for disease outbreak detection. The system analyses various data sources, such as social media feeds, hospital records, and weather patterns, to identify potential disease outbreaks in real time. By monitoring trends and patterns, the AI system can quickly detect and respond to outbreaks, enabling healthcare authorities to take timely measures to control the spread of diseases. This AI application has

[168] Cravero, A.; Pardo, S.; Galeas, P.; López Fenner, J.; Caniupán, M. Data Type and Data Sources for Agricultural Big Data and Machine Learning. Sustainability 2022, 14, 16131. https://doi.org/10.3390/su142316131.

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significantly improved the early detection of outbreaks, allowing for faster response and containment efforts, ultimately saving lives, and preventing the escalation of public health emergencies.

5.11.4 AI-POWERED DIAGNOSIS ASSISTANCE IN RADIOLOGY IN SOUTH AFRICA

In South Africa, an AI-based solution was implemented to assist radiologists in diagnosing medical images, particularly for diseases like tuberculosis (TB) and lung cancer. The system uses deep learning algorithms to analyse medical images, identify abnormalities, and provide diagnostic recommendations to radiologists. This AI application has been instrumental in improving the accuracy and efficiency of diagnosis, enabling healthcare professionals to detect diseases at an early stage and initiate timely treatments. By reducing the time taken for diagnosis and improving accuracy, this AI solution has had a significant impact on improving patient outcomes and reducing mortality rates associated with TB and lung cancer.

5.11.5 AI-POWERED MOBILE APPLICATIONS FOR REMOTE HEALTHCARE IN KENYA

In Kenya, mobile applications powered by AI have been developed to address the challenges of providing healthcare in remote and underserved areas. These applications utilise AI algorithms to assess symptoms, provide medical advice, and connect patients with healthcare professionals through telemedicine services. Through these AI-powered mobile applications, individuals in remote areas can access healthcare advice and consultations without the need for physical visits to healthcare facilities. This has not only improved healthcare accessibility but also reduced the burden on overcrowded healthcare facilities, enabling more efficient allocation of resources. These AI applications have been particularly impactful in areas with limited healthcare infrastructure and a shortage of medical professionals.

These case studies highlight the significant impact of AI applications in healthcare in Africa. From disease outbreak detection and diagnosis assistance to remote healthcare delivery, AI has improved the efficiency, accuracy, and accessibility of healthcare services. By leveraging AI technologies, African countries are enhancing their healthcare systems, addressing challenges related to resource constraints, and ultimately improving patient outcomes and population health. These AI applications have the potential to transform healthcare delivery in Africa, particularly in underserved regions, and contribute to achieving sustainable development goals in the field of health.

5.11.6 AI-POWERED CREDIT SCORING IN KENYA

In Kenya, a fintech company developed an AI-based credit scoring system that leverages alternative data sources to assess the creditworthiness of individuals who have limited or no formal credit history. The system analyses various data points such as mobile money transactions, utility bill payments, and social media activity to build a comprehensive credit profile for individuals. By using AI algorithms to analyse these alternative data sources, the system provides more accurate and inclusive credit scores, enabling financial institutions to offer loans and financial services to previously underserved populations. This AI application has had a significant impact on expanding access to finance, empowering individuals, and small businesses with better access to credit and financial opportunities.

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5.11.7 AI-DRIVEN FRAUD DETECTION IN BANKING IN NIGERIA

In Nigeria, banks have implemented AI-based systems to detect and prevent fraudulent activities in real time. These systems use machine learning algorithms to analyse large volumes of transaction data, identifying patterns and anomalies that could indicate fraudulent behaviour. By automating the fraud detection process and continuously learning from new data, these AI solutions have significantly improved the efficiency and effectiveness of fraud detection in the banking sector. This has helped financial institutions reduce losses due to fraud, protect customer assets, and maintain trust in the banking system. The implementation of AI-driven fraud detection has not only enhanced the security of financial transactions but has also streamlined operations and improved overall customer experience.

5.11.8 AI-POWERED CHATBOTS FOR CUSTOMER SUPPORT IN SOUTH AFRICA

In South Africa, financial institutions have adopted AI-powered chatbots to enhance customer support services. These chatbots utilize natural language processing and machine learning algorithms to understand customer queries and provide personalized responses. By leveraging AI, financial institutions can handle a large volume of customer inquiries simultaneously, offer 24/7 support, and provide instant responses to common queries. This has improved customer satisfaction, reduced response times, and lowered operational costs for financial institutions. Moreover, the chatbots can learn from customer interactions, continuously improving their performance and providing more accurate and relevant information to customers.

5.12 AI READINESS INDICES

The 2021 AI Readiness Index ranks 160 countries by how prepared their governments are to use AI in public services. The USA tops the rankings, followed by Singapore in second place and the UK in third. Nearly 40% of countries included in the index have published or are drafting national AI strategies; and East Asian countries showed strength, making up one-quarter of the top 20 ranked countries. Nearly 40% of the 160 countries ranked in the 2021 AI Readiness Index have published or are drafting national AI strategies, demonstrating that AI is quickly becoming a top concern for world leaders. 30% of ranked countries have already published a national AI strategy while 9% are drafting one.

The scores of the Government AI Readiness Index 2021 show clear disparities amongst and within regions. Africa, particularly Sub-Saharan Africa, is trailing other regions on the readiness index. The average score of the two lowest-ranked regions is 36.27 (Sub-Saharan Africa and Central & South Asia), whereas the average for the top two is more than double that, with 76.75 (North America and Western Europe). There is also an evident divide within regions.

The African nations need to move with speed in developing necessary operational frameworks for the adoption of artificial intelligence, such as national AI strategies. Such strategies should be aligned with this AU Continental Strategy. Therefore, countries that might have already developed their national AI policies are encouraged to review them for such alignment.

5.13 RECOMMENDATIONS AND ACTION PLANS

The recommendations to bolster data infrastructure for AI in Africa were summarised as follows:

a) African Governments should create market demand on the continent for the use of existing local data centres by identifying key data stakeholders such as data service providers, start-up companies, researchers, general public sector, and private sector, among others, present on the

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continent. This can be accomplished by engaging with these stakeholders, identifying their needs, and revising the availability of existing local data centres.

b) National Ministries of Education should stimulate the interest of students to embrace careers in the field of data to close the skills gap in the local data market by adding to the academic curriculum such as data literacy and technical data competency courses. This can be accomplished by providing scholarships to study data management and encouraging businesses to hire local data practitioners such as data engineers, data scientists, and data policymakers, among others, for internship and/or full-time employment opportunities.

c) There is a need for skills development in data governance to enable collaborations and sharing of infrastructure. Funds should be allocated to local universities for research, to acquire modern tools for data management, and to support reliable connectivity between different universities for data knowledge sharing.

d) Data centres consume a lot of energy, and it remains impractical to create data centres without addressing the issues around energy, the need for the market, and optimising the utilisation of data centres to prevent underutilisation. This holistic approach will enable all entities to have local data storage and enhance the local market. For example:

    a. Quantify the current energy use and need for the development and use of data centres.

    b. Collaborate with service providers to build tier 4 green energy data centres to enable reliability, instead of relying on the unreliable national grid.

    c. African countries should embrace collaboration and build common data centres based on a strategic location and available resources such as data infrastructure and governance that will be most cost-effective, benefit all, and reduce energy consumption on the continent.

e) The AU should promote and encourage its Member States to invest in secure regional data centres and stimulate data sharing across different countries.

f) Have a uniform approach in laws, regulations, and policies, as guided by AU policies and frameworks on data usage and data centre management on the continent.

    a. The data policies should consider the level of development, ownership, access to data, and the need for a reliable grid.

    b. International companies should comply with the established data regulations before offering their services on the continent. Under penalties and exclusions from the market.

    c. International companies should contribute to the economic growth of African countries where they are operating by signing into partnerships defined by local governments based on revenue sharing agreements, controlling African data collection, and co-managing cloud servers containing African data. Also, other potential forms of partnership can be put in place at the national level to increase opportunities and enhance the legal jurisdiction of data being hosted outside Africa and within African countries. For example, if Meta (Facebook) is installing data centres and fibres around the continent with small computing centres around the shores, then African countries can negotiate and partner with these institutions. This will improve the optimal utilisation of data centres in collaboration with the private sector.

g) African Governments should support local data initiatives, by providing funds to start-up companies and encouraging the use of local cloud computing providers by local institutions.

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5.13.1 HIGH-PERFORMANCE COMPUTING AND HIGH-THROUGHPUT SYSTEMS

a) Africa should establish strategic regional and continental high-performance computing centres, big data storage systems and fast connectivity.

b) There is a need to invest more in green sources of energy to mitigate the potential power challenges that may arise due to high-performance computing needs.

5.13.2 DEFINING AFRICAN AI ETHICS

a) AU Member States should collaboratively establish unified legal systems that clearly define AI ethics, offering protection and binding obligations across the continent.[169]

b) Encourage the ratification and implementation of the AU Convention on Cybersecurity and Personal Data Protection among AU Member States.

c) AU Member States should domesticate UNESCO's Recommendation on the ethics of artificial intelligence.

5.13.3 BUILDING OPEN VERIFIABLE NATIONAL DATABASES

a) AU Member States should establish well-resourced national data systems that comply with the standards and quality principles recommended in the AU Data Policy Framework. The AU Data Policy Framework represents a significant step toward creating a consolidated data environment and harmonized digital data governance systems to enable the free and secure flow of data across the continent while safeguarding human rights, upholding security, and ensuring equitable access and sharing of benefits.

b) Comply with eco-friendly principles, build 4-tier green-powered data centres. Understandably, Member States are at different levels of capability. Therefore, Africa should develop modalities of pooling resources into establishing regional and 4-tier green data centres.[170]

5.13.4 CREATING AND PROTECTING INTELLECTUAL PROPERTY AND FAIR USE

Innovation and creativity are the core drivers of sustainable economic development, and intellectual property rights are the key tools to generate value from intangible assets. A strong enabling environment for IP creation, protection, administration, and enforcement will boost the participation of African countries in the world economy and stimulate innovation and competitiveness in the private sector.

AU RECs and Member States should respectively develop regional and national frameworks and tools for the promotion and protection of intellectual property accruing on the continent. The frameworks should specifically aim to create, protect, utilise, administer, and enforce Intellectual Property Rights across Africa, in line with international best practices and support of the AfCFTA and the African Union's Agenda 2063.[171]

[169] http://africadca.org/wp-content/uploads/2021/12/ADCA-Annual-Report-2022_Final-1.pdf?succes=1677534348.
[170] https://unstats.un.org/unsd/trade/events/2014/beijing/documents/globalpulse/Big%20Data%20for%20Development%20-%20UN%20Global%20Pulse%20-%20June2012.pdf.
[171] https://www.turnerandtownsend.com/en/perspectives/data-centre-cost-index-2020/.

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5.13.5 SYNTHETIC DATA AND DATA MODELLING

The use of synthetic data in AI has gained prominence as a means to enhance algorithm performance by supplementing real data. However, the question remains: Are synthetic data as effective as real data when it comes to classifying real human actions? Researchers from MIT, the MIT-IBM Watson AI Lab, and Boston University embarked on a study to answer this question.

To conduct their research, the team constructed a synthetic dataset consisting of 150,000 video clips capturing a diverse range of human actions. This synthetic dataset was then utilised to train machine-learning models. Subsequently, the researchers evaluated the performance of these models by exposing them to six different datasets of real-world videos and assessing their ability to recognise human actions within those clips.

The findings of the study indicated that the models trained on synthetic data outperformed models trained solely on real data in cases where the videos had fewer background objects. This suggests that synthetic data can offer higher accuracy and performance compared to models trained solely on real data, potentially mitigating concerns related to privacy, copyright, and ethics associated with the use of real data.

In the African context, where data that is representative of diverse societies is often limited, the use of synthetic data becomes even more significant. By generating synthetic data that reasonably augments real data, African countries can address the scarcity of representative data and leverage AI technologies more effectively. This approach can help bridge the data gap and enable African researchers and practitioners to develop AI models that accurately reflect the characteristics and nuances of their local contexts.[172]

However, it is important to note that the quality and realism of synthetic data play a crucial role in its effectiveness. Synthetic data should be appropriately modelled to capture the complexity of real-world scenarios and accurately represent the target population. The development of robust synthetic data generation techniques, tailored to the African context, will be essential to ensure the reliability and usability of synthetic data in AI applications.

Finally, the study's findings highlight the potential of synthetic data to enhance AI algorithms' performance, particularly in scenarios where real data may be limited. The use of synthetic data, when appropriately modelled, can contribute to advancing AI capabilities, addressing data scarcity challenges, and enabling African countries to harness the power of AI to drive sustainable development and tackle societal issues.

5.13.6 PILLAR 2 ROADMAPS, GOALS AND TARGETS

This pillar challenges African countries with the following:

a) African countries should establish strategic regional and continental high-performance computing centres, big data storage systems and fast connectivity by 2030.
b) Africa should create at least a 4-tier regional data centre for each of its RECs.
c) There is also a need to establish green sources of energy to mitigate the potential power challenges that may arise due to high-performance computing needs at these centres, during the same period of implementation.
d) Broadband should be intensified to at least 75% coverage on the continent by 2030. Access to smart devices, power, and affordable internet should be democratized to the same percentage point at the same time.

[172] https://news.mit.edu/2022/synthetic-data-ai-improvements-1103, accessed on 28/02/23.

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e) To enhance data governance part, AU Member States should fully ratify their policies according to the Malabo Convention by 2025. This can mark a significant milestone in establishing standardised data governance practices across the African continent.
f) African countries should also cooperate in establishing data monetisation regimes and cross-border data movement systems by 2030.

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6 PILLAR 3: ENABLING ENVIRONMENTS FOR AI DEVELOPMENT AND DEPLOYMENT

6.1 GOALS AND TARGETS

The African Union (AU) Member States are at various levels of AI adoption.[173] However, globally AU Member States are ranking low in AI technology development and implementation. As such, the AI space is largely dominated by the West and Asia countries. Within these countries, AI is led by technology companies that are even richer than individual countries. These companies have created applications that are influencing and changing social norms and cultures. Therefore, this calls for a multi-level approach to AI governance at AU Member States' national, regional economic communities (RECs), and the continental level. Pursuing efficient AI governance can create an enabling environment for AI implementation in Africa. To outline the internet considerations towards creating an enabling environment, this section was sub-divided into major areas to include AI foundations to enable access to quality data and AI technology, creating a supportive AI ecosystem to enhance effective AI governance and regulations and strengthen awareness and technical know-how to enhance Africa's comprehensive AI participation, even at local levels.

6.1.1 THE FOUNDATIONS ENABLING ACCESS TO QUALITY DATA AND AI TECHNOLOGIES

To enable access to quality data, all Africans should have universal, equitable access to affordable broadband technology. Therefore, by 2030, all African countries should have a well-funded and strategic national plan to provide comprehensive and cost-effective access to broadband for their citizens. Furthermore, all African countries should strengthen their gender equality-based access to broadband. African countries are also encouraged to have a data strategy to include open data and linking private and public sector data. As such, African countries should develop a data marketplace strategy that can address how to capture value from data, formulate clear data standards that can meet international requirements, and institutionalise a clear strategy for open data and a portal to make governmental open data accessible to its citizens.

Furthermore, African governments are challenged to formulate practical steps to develop an enabling environment for the handset and device affordability for all its citizens. African governments can accomplish this by 2030 by implementing specific policy considerations to lower device and equipment costs for their citizens. Furthermore, African governments can implement specific policy considerations to support device and equipment financing schemes.

6.1.2 EFFECTIVE GOVERNANCE AND REGULATIONS

According to the Oxford government, AI Readiness Index 2022, the OECD, and WIPO, several policy instruments and laws should be in place to ensure effective governance and regulations in the AI space. These instruments will enable AI development and deployment to thrive while protecting the individuals and businesses interacting with it.[174] These instruments include national AI strategy, data privacy and protection laws, national data strategy, cyber security laws, ethical AI framework, AI governance regulations, patent and intellectual property laws, and competition and liability laws. Some of these instruments may already exist in a country because they are part of the general data and business

[173] https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf.
[174] Qatar 2020, National AI for Qatar, https://qcai-blog.qcri.org/wp-content/uploads/2020/04/QCRI-Artificial-Intelligence-Strategy-2019-ENG.pdf

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ecosystem regulations. However, some of such would need to be amended to cater to the new aspects that AI may introduce.[175]

6.1.3 CREATING A SUPPORTIVE AI ECOSYSTEM TO MAKE AI PRACTICAL IN AFRICAN SOCIETIES

African countries can make AI practical in African societies by adopting AI as a key technology for addressing national socioeconomic needs. This can help drive demand and spur local innovation. This can be accomplished by developing AI solutions to enhance peoples' quality of life in economic sectors such as education, governance, health, retail, finance, and the environment, among others. Particularly, the usage of AI can substantively solve Africa's endemic social and economic challenges and further promote public and private partnerships in the development and deployment of AI technology.

African countries should also engage the public sector to procure AI systems to enhance service delivery. This can be accomplished by providing incentives for the development and deployment of AI such as improving governmental fiscal management, providing tax holidays for enterprises, and simplifying business registration processes, among other things. To this end, African governments are challenged to make direct investments in AI activities such as research, development, innovation, and commercialisation. This can make AI available and accessible to all potential users especially small-and-medium businesses including start-up companies. This can also help democratise AI to become a digital public good data repository and management mechanism.

6.1.4 ENHANCED KNOWLEDGE OF AI AT ALL LEVELS TO STRENGTHEN TECHNICAL CAPACITY

To enhance knowledge of AI at all levels to strengthen technical capacity, African countries should create National Programmes to demystify AI among different segments of society. This can be accomplished by creating AI clubs and communication material to explain AI in a simple but interesting manner. These can include flyers and animations in different local languages. African countries should also prepare citizens for the future of work. This can be accomplished by introducing skilling and reskilling development efforts through various training programmes. Additionally, African countries should adopt and prioritise the inclusion of modern technology in the education sector spanning all levels.

African countries should also support the development of AI, data science, and digital skills. This includes supporting a broad range of people to enter AI-related jobs by ensuring career pathways and highlighting opportunities to work with and develop AI. This can be accomplished by launching National AI Research and Innovation programmes to align funding programmes and support the wider ecosystem. African countries should also support the diversity in AI by continuing existing interventions across top talent, PhDs, AI and Data Science conversion courses and industry-funded courses.

6.2 THE FOUNDATIONS: ACCESS TO QUALITY DATA AND AI TECHNOLOGIES

Most African countries lack the infrastructure required for robust and inclusive AI adoption. However, for AI to thrive, African countries should invest massively in infrastructure. This includes investing in reliable internet and broadband connectivity to drastically improve performance. This means African countries should ensure the nationwide rollout of the 5G network and the closing of the rural-urban

[175] Sweden 2020, National approach to AI, https://www.government.se/4a7451/contentassets/fe2ba005fb49433587574c513a837fac/national-approach-to-artificial-intelligence.pdf

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connectivity gap. With several countries creating data localisation laws, there is a need for tier 4 data centres to store data. Additionally, African countries also require National Cloud Based shared infrastructure that provides scalable storage and compute resources. Furthermore, investments are needed to secure high-performance computing resources, access to AI semiconductor technology, and next-generation AI that will aid AI research.

6.2.1 UNIVERSAL CONNECTIVITY, AFFORDABILITY, ACCESS, EQUALITY AND USE OF BROADBAND

AI cannot thrive without broadband. Hence, African countries should work towards universal broad penetration. This can ensure reliable digital infrastructure and digital inclusion as these are fundamental for robust and inclusive AI in Africa. Such efforts can enable even greater access to the AI community's internet and digital infrastructure, hardware, and cloud computing services. Currently, internet penetration is incomplete, particularly in rural areas, and this poses challenges in terms of affordability and reliability with consequences for inclusion. Similarly, access to international world-class cloud service providers is unaffordable for AI start-up companies, students, and practitioners. Now, international cloud providers are offering computing capabilities that are unmatched by domestic options in terms of reliability, quality, efficiency, security, and scalability. Therefore, a path to affordable access to world-class computing for AI/ICT start-up companies and companies while mitigating risks related to security and privacy is necessary. For instance, Ghana is preparing to build a national cloud infrastructure with AI-ready storage and computing capacity serving the region and the African continent.

6.2.2 ACCESS TO QUALITY TRAINING DATA FOR INNOVATION AND COMMERCIALISATION

Inadequate provision and/or access to quality data is a major challenge in African countries. This is coupled with sub-optimal data connectivity, insufficient open government data, and a lack of data standards.[176] Most importantly, data is the lifeblood of AI and without quality data, AI applications cannot be built to solve Africa's numerous challenges. Therefore, to improve access to quality data, African countries should have a data strategy that covers the collection, management, and use of data. African countries should create data-sharing policies and data marketplaces conditions that support the collection of the right type of data from the right sources using the right mechanisms.

The data marketplace strategies should address how this data that is collected is stored, protected, and curated in addition to the issues of accessibility, availability, monetization, opening, and reuse of data. The data marketplace strategy should include recommendations for establishing trusted data intermediaries for public-private data exchange.[177] Markedly, data sharing should also include strategies on how to open datasets that can be leveraged for national development. Fundamentally, the African government should create a stable and AI-friendly data environment with a focus on the public sector by creating national open government initiatives.[178] African governments should also strengthen the linkage between public and private data maps and establish a framework for public-private data collaboration. Furthermore, data standards that promote the ease of use of data and meet international requirements should be established in African countries.[179]

[176] AU Data Policy Framework, https://au.int/sites/default/files/documents/42078-doc-AU-DATA-POLICY-FRAMEWORK-ENG1.pdf

[177] Singapore's Model Artificial Intelligence governance framework (2020) 2nd Edition, https://www.pdpc.gov.sg/-/media/files/pdpc/pdf-files/resource-for-organisation/ai/sgmodelaigovframework2.ashx

[178] Bangladesh 2019, National Strategy for Artificial Intelligence Bangladesh, https://ictd.portal.gov.bd/sites/default/files/files/ictd.portal.gov.bd/page/6c9773a2_7556_4395_bbec_f132b9

[179] Lithuanian 2020, Lithuanian Artificial Intelligence Strategy, http://kurklt.lt/wp-content/uploads/2018/09/StrategyIndesignpdf.pdf.

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6.2.3 DIGITAL INFRASTRUCTURE AND INCLUSION

For African countries to deploy AI systems at the national level, they need to have a public digital infrastructure that is inclusive. African governments should, therefore, work towards providing the infrastructure and mechanisms for AI knowledge sharing. These include access to affordable high-speed broadband networks, computing power, and data storage which has been emphasised under pillar 2: Infrastructure and Data.[180] However, the focus of this section is on the provision of inclusive digital infrastructure that will enable the deployment of AI systems and ensure that all citizens benefit from the technology.

An inclusive digital infrastructure should have four essential pillars that will make it necessary for the deployment of AI systems to citizens. They are digital identity, consent, interoperability, and data exchange. A trusted digital identity enables individuals, businesses, and public institutions to represent themselves in the digital economy. Consent ensures that there is a system of regulations, laws, and other requirements to ensure individuals understand how their information is being used to ensure transparency and accountability. Interoperability requires that different systems can communicate with each other to ensure verification and exchange of information. Finally, data exchanges make data available for national AI systems for a specific period and purpose.[181]

Digital public goods – "open-source software, open data, open AI models, open standards, and open content that adhere to privacy and other applicable laws and best practices, do no harm by design, and help attain the Sustainable Development Goals"- can form an important component of inclusive digital infrastructure.[182] Building inclusive digital infrastructure for all citizens including women, the elderly, people with disabilities, people living in low-connectivity areas, and with varied levels of literacy requires a people-centred approach. While Digital Public Goods do not guarantee inclusivity on their own, they can be key components of building an inclusive digital infrastructure.[183]

6.2.4 ACCESS TO AI TECHNOLOGY

For Africa to catch up with the rest of the world, open approaches to AI are necessary. This will require the countries on the continent to work towards the democratisation of AI. Democratising AI means making the technology available to all including people without specialized skills in AI. This means making elements such as data, storage and computing, models, algorithms, and marketplace digital public goods, especially for AI projects for governments or that utilise government or public funds or data.[184]

Examples of systems that have practicalised the democratisation of AI are the Lacuna Fund for Data[185] and Kaggle for a marketplace[186]. The Google Cloud Platform is a suite of cloud computing services that can be used by people with less programming skills to build and train image classifiers[187] and the Google Colab is an open-source platform for building models online[188].

[180] https://oecd.ai/en/dashboards/ai-principles/P11
[181] https://www.mas.gov.sg/-/media/MAS/Fintech/FDI/Foundational%20Digital%20Infrastructures%20for%20Inclusive%20Digital%20Economies.pdf.
[182] https://digitalpublicgoods.net/digital-public-goods/.
[183] https://digitalpublicgoods.net/blog/digital-public-infrastructure-for-an-inclusive-future/.
[184] https://www.turing.com/kb/ultimate-guide-to-democratization-in-ai#which-elements-should-be-democratized?
[185] https://lacunafund.org/datasets/
[186] https://www.kaggle.com/
[187] https://cloud.google.com/
[188] https://colab.research.google.com/#

Democratising AI will ensure that the barriers to entry into AI are reduced for individuals and organisations, the cost of AI projects is minimized, encourage collaboration and innovation and efficiency will improve. However, the process of providing open access should be managed. To guard against the negative effects of open AI, there should be clear guidelines for training for users, data governance, model governance, Intellectual Property Rights and Open Sourcing[189].

6.2.5 PRICE OF DEVICES AND EQUIPMENT

For AI to thrive in African countries, policymakers and decision-makers should ensure that the cost of devices and equipment is affordable. As a mobile-first continent, [190]African countries should especially address the cost of mobile devices. For instance, the Alliance for Affordable Internet (A4AI) reported that in Sub-Saharan Africa, the average cost of a smartphone is 45% of the average monthly income.[191] This makes access to smartphone devices and equipment necessary to advance AI applications difficult.

To address the cost-effectiveness challenge of smartphones in Africa, governments should implement some policy interventions. For instance, African countries should implement policy considerations that can significantly reduce taxes and fees on devices and equipment. For example, the removal of Value Added Tax on mobile devices in Pakistan increased the sale of mobile devices by 25%.[192] Therefore, African governments can also emulate Rwanda by providing device and equipment subsidies for targeted user groups. This is also necessary for African countries to assess whether it is feasible to reduce the cost of devices and equipment by producing them on the continent.

Additionally, in an AI-driven economy, it will be necessary to take practical steps to implement policy considerations to support device and equipment financing schemes. Therefore, policy consideration may include creating an enabling environment for the development of innovative approaches to credit and creating public-private partnerships to de-risk handset financing.[193] This will significantly influence affordability and access to cheap devices and equipment.

6.3 EFFECTIVE GOVERNANCE AND REGULATIONS

African countries can realise the full potential of AI if there are supporting policies and regulations. These enabling policy and regulatory frameworks can provide guidelines for implementation and also keep AI development in check for negative impacts. Therefore, for AI to flourish, African countries should implement policy and regulatory considerations that can include data management. These can be safeguarded by data protection and privacy, cybersecurity, data sharing, data use, data governance, cyber security, and data interoperability, among others. Furthermore, infrastructure should include AI ethics considerations and research, development, and innovation mechanisms and ecosystem.

To encourage the widespread deployment and use of AI, African governments should assure citizens that AI technology is beneficial and safe to use. Thus, African countries should establish industry-led AI Councils that will oversee the responsible and ethical use of AI. African countries should also build on existing data protection and privacy regulations. In such cases, the AI council can be responsible for assisting with the formulation and implementation of responsible and ethical AI policies. This can lead to the establishment of AI ethics, and the prevention of AI dysfunction. In addition to the establishment of the AI council, African governments should develop an AI regulatory environment that also promotes ethics, data privacy, and security and provide the right regulations that promote robust but sustainable use of AI. This will ensure product safety and the trustworthiness of AI applications. Particularly,

[189] https://www.turing.com/kb/ultimate-guide-to-democratization-in-ai#which-elements-should-be-democratized?
[190] https://techcabal.com/2022/08/22/mobile-first-africa/.
[191] Device Pricing 2021 - Alliance for Affordable Internet (a4ai.org).
[192] GSMA | Rethinking mobile taxation to improve connectivity 2019 | Public Policy.
[193] Making internet-enabled phones more affordable in low- and middle-income countries (gsma.com).

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sectoral regulatory frameworks and intellectual property regulations should also shift with the changing times. Furthermore, with the shifting regulatory paradigm in the AI field, African countries should encourage self-regulation by the AI industry, innovative and intelligent information protection regulatory sandboxes, and the establishment of a future-oriented legal system for this era of AI.

6.3.1 POLICY AND REGULATORY GAP ASSESSMENT FOR AI IN AFRICA

Africa's engagement with AI necessitates the establishment of robust regulations and policies to ensure responsible and ethical development, implementation, and use of this technology. While the OECD offers recommendations to its member states, the unique circumstances and demographics of African countries demand tailored approaches. African nations should prioritise the formulation of policies that consider local contexts, such as access to data, equitable distribution of costs and benefits, environmental sustainability, and green IT. To effectively translate these policies into practical measures, legislation and regulation are crucial.

The following key areas should guide the development and utilisation of AI in Africa:

a) Basic and applied research in AI: Encouraging research in AI will foster innovation and knowledge creation within the continent, enabling African countries to contribute to the global AI landscape effectively.
b) AI talent attraction, development, and retention: Investing in the development of AI expertise is essential to nurture a skilled workforce that can harness the potential of this technology. Strategies should focus on attracting talent, providing quality education, and training programmes, and implementing measures to retain AI professionals within the continent.
c) Future of work and skills: As AI continues to reshape the labour market, African countries should anticipate these transformations and proactively equip their workforce with the necessary skills. Policies should support reskilling and upskilling initiatives to ensure individuals can adapt to evolving job requirements.
d) Industrialization of AI technologies: Promoting the development and adoption of AI technologies within African industries can enhance productivity, competitiveness, and economic growth. Policies should facilitate collaboration between the public and private sectors, incentivise AI integration, and address potential challenges related to intellectual property and innovation.
e) Public sector use of AI: Governments should establish guidelines for the responsible deployment of AI in public services. This includes ensuring transparency, fairness, and accountability in decision-making processes, as well as safeguarding citizens' privacy and data protection.
f) Data and digital infrastructure: Creating a supportive ecosystem for AI requires robust data and digital infrastructure. Policies should focus on improving data collection, quality, and accessibility, as well as promoting the development of secure and reliable digital infrastructure to support AI applications.
g) Ethics: Ethical considerations should underpin AI development and use in Africa. Policies should address issues such as bias, fairness, accountability, and the potential societal impacts of AI technologies, ensuring that they align with local values and norms.
h) Regulation: Effective regulation is crucial to prevent the misuse or abuse of AI technologies. African countries should establish clear guidelines and frameworks to govern AI development, implementation, and use while considering potential risks and ensuring compliance with international standards.
i) Inclusion: Policies should aim to bridge the digital divide and ensure that the benefits of AI are accessible to all segments of society, including marginalized communities. Efforts should be made to mitigate inequalities and promote inclusive development through targeted interventions and initiatives.
j) Foreign policy: African countries should actively engage in international discussions and collaborations on AI to shape global governance frameworks and advocate for their interests.

Cooperation with other nations and organisations can facilitate knowledge exchange, capacity building, and the establishment of shared ethical and regulatory standards.

By addressing these key areas through well-designed policies and regulations, Africa can harness the transformative potential of AI while safeguarding against potential risks and ensuring that its development and use align with the continent's unique needs and values.

6.3.2 AI POLICIES AND GOVERNANCE

AI strategy for the African Continent and African Countries: There is a need for a well-documented strategy for AI in Africa as there is in Europe, Canada, the U.S., and China. However, only a few countries in Africa, including Mauritius, and Egypt have comprehensive AI strategies for their countries. This standing makes the African continent/African countries vulnerable to foreign AI technologies that dominate the region, offering technological products and solutions that may not be compatible with local developmental priorities or unfair trade agreements. Therefore, African governments should develop individual comprehensive AI strategies for their countries. In addition, the African Industry-led Council proposed in the previous section should commission the development of an AI strategy for the African continent to guide AI Development and adoption.

When considering the ethical AI framework, in all the attempts to govern AI, the starting point starts with drafting clear Ethical AI principles. These principles should be consistent and aligned with societal values and norms and these should be inspired by human rights and fundamental freedoms enshrined in a country's constitution and regulations[194]. A comprehensive list of these principles can be compiled from the UNESCO Recommendations on the Ethics of AI, and reports from other international fora including the Global Privacy Assembly (GPA), Council of Europe (CoE), European Union (EU), and Organisation for Economic Co-operation and Development (OECD). These frameworks are providing a good starting point for ethical AI principles, taking the experience of UN Global Pulse's work with the government of Uganda, through desk reviews of the above reports, stakeholder interviews, and a survey to prioritisation and cluster AI ethical principles resulted in 9 Foundational and 34 Guiding AI Ethics principles.

The ethical principles alone cannot guarantee ethical AI unless precise policy implementation mechanisms and interventions to translate them into practice are clearly defined. Moreover, since AI and digital technologies are known to create new social worlds, societal norms are expected to change. Therefore, comprehensive mechanisms and tools should have an appropriate balance between technical capability and social responsibility. Therefore, mechanisms for translating ethical AI into practice can be borrowed from medicine, since this is a field with a long history of ethical practice. These mechanisms include professional societies and boards, ethics review committees, accreditation and licensing schemes, peer self-governance, and codes of conduct. Consequently, these mechanisms bring clarity on what practices should be incentivised and provide a yardstick to sanction bad actors.

Figure 7 summarises the process a country can take to develop ethical AI principles through to finally developing an Ethical AI framework that could be used to institute an AI governance. Note that the national AI strategy can be developed before or at any point along the process before the final Ethical AI framework.

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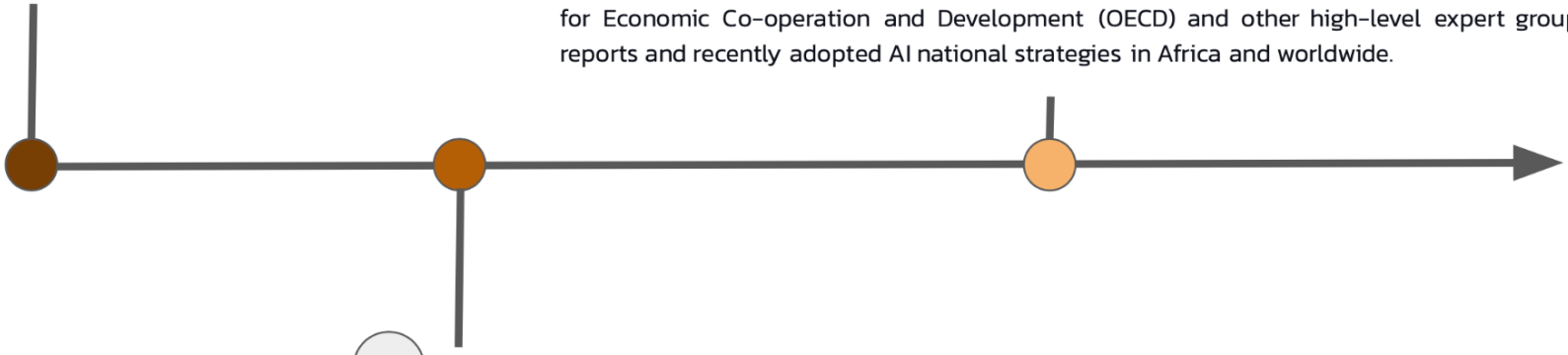
[194] UNGP, Ministry of ICT and National Guidance Developing framework for ethical AI Roadmap options for Uganda.

Policy Mapping 1

Carry out a policy mapping to ascertain whether current regulations and policies are sufficient to address the risks and challenges inherent to AI in the country.

Ethical AI Principles 3

For a country to ensure that the resultant ethical AI principles are consistent and compatible with regional and international approaches, governments need to review existing and emerging regulatory and ethical implementation frameworks for AI and Machine Learning. These include the UN Secretary-General's Roadmap for Digital Cooperation, UNESCO Recommendations on the Ethics of AI4, and work in other international fora, such as the Global Privacy Assembly (GPA), Council of Europe (CoE), European Union (EU), Organisation for Economic Co-operation and Development (OECD) and other high-level expert group reports and recently adopted AI national strategies in Africa and worldwide.



Values and principles 2

Identify underlying values and principles that need to be upheld and followed in the country from existing government statutes, policies and strategies. These values and principles form the foundation but ensure that countries' cultures and heritage are not disregarded in the final ethical AI principles.

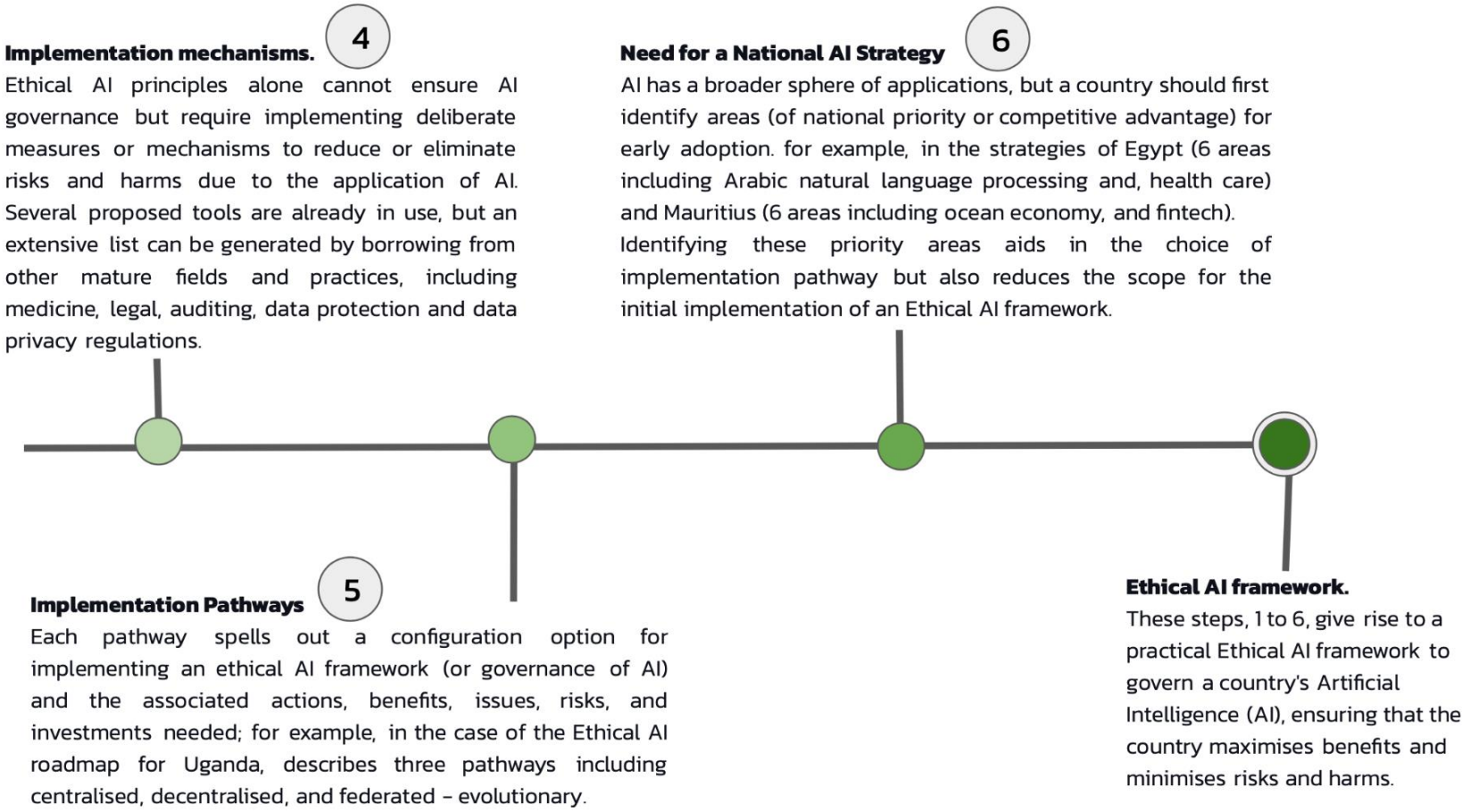


Figure 7. Setting up an ethical AI framework.

Although the National AI Strategy in the steps is at number 6, it is not a requirement to be in that position, it could even come at the beginning but is required in choosing an implementation pathway to finally use in the implementation of the Ethical AI framework.AI Legislation: Existing laws relevant to the provision of electronic services may, to some degree, also apply to AI systems. Particularly, uninformed approaches to governance can lead to systemic biases. For instance, overregulation can stifle innovation, thus limiting the opportunities that can be leveraged. This can further create an environment for political abuse. In the same way, under-regulation can result in cultivating a culture whereby trust and confidence are absent. This can consequently render consumers and citizens unprotected.[195]

As of September 2022, the lack of dedicated AI legislation in African countries, with Mauritius being the sole exception with partial legislation for licensing procedures related to AI-enabled investment and portfolio management services, highlights a concerning gap in addressing the potential risks and implications of artificial intelligence on the continent. Without specific regulations and guidelines, Africans are left vulnerable to the adverse effects of AI, such as biased decision-making algorithms, privacy breaches, and unequal access to AI-driven opportunities. This underscores the urgent need for African nations to develop comprehensive AI frameworks to safeguard their citizens, promote ethical and responsible AI practices, and harness the potential benefits of this transformative technology for sustainable development and inclusive growth.

6.3.2.1 MECHANISMS FOR AI REGULATIONS AND GOVERNANCE

Self-Regulation: Self-regulation is important in guiding the appropriate action in the absence of, or in anticipation of, statutory controls. Self-regulation is undertaken through sectoral codes of conduct or industry standard practices. This mechanism is more responsive to societal and technological changes than a formalised standard or statutory regulation, which can take time to develop and may entail significant procedural hurdles. The reason is that self-regulation reduces the scope of ethical principles to translate into actional ethical practices. This is because of the specific nature of AI applications in the given sector. Furthermore, self-regulation also allows for the amendment of current regulations in the industry to cater to new aspects introduced by an AI application.

Examples of sectoral self-regulations are in the case of Mauritius in the perspective of increasing the capacity of existing Ethics Committees in the Health Sector.[196] There is also the National AI Strategy in India that advocates for domain-specific ethical councils to aid in developing sector-specific guidelines on privacy, ethics, and security.[197] Further to this, in 2018, the UK government adopted the sectoral approach as they found it more appropriate. However, their new National AI strategy[198] has also proposed some cross-sectoral approaches. This was mainly because there are overlaps between specific regulations and inconsistent approaches across sectors. Examples of the areas proposed under cross-sectoral include data protection and human rights and equity, and those under sectoral are financial services and medical products. Their first take on the sectoral approach allowed them to identify areas requiring a cross-sectoral approach.

Standards and Certification Schemes: Standards and Certification Schemes provide objective and transparent benchmarks for organisations and processes to be assessed against; This requires well-laid-out standards, assessments, and a certification body that issues certificates after carrying out checks or verifying self-assessments. The EU AI Act requires high-risk AI systems to undergo conformity assessment before being given a certificate in the European Union.[199]

[195] ''AI For Africa'' Blueprint First Edition©2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.
[196] Mauritius 2018, The Mauritius Artificial Strategy, https://ncb.govmu.org/ncb/strategicplans/MauritiusAIStrategy2018.pdf.
[197] The US Algorithmic Accountability Act (US AAA) of 2022 https://www.congress.gov/117/bills/hr6580/BILLS-117hr6580ih.pdf.
[198] United Kingdom 2021, National AI Strategy, https://www.pdpc.gov.sg/-/media/files/pdpc/pdf-files/resource-for-organisation/ai/sgmodelaigovframework2.ashx.
[199] EU AI Act 2021 https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF.

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Statutory Regulation and Enforcement: The regulation of AI should be adaptable to the ever-changing landscape of emerging technology. Thus, a blanket approach to the regulation of AI and enforcement of rules, standards and/or ethical guidelines is unlikely to yield an advantageous mode of AI regulation. The regulation of AI may on a broad scale be categorised into two main categories, hard and soft regulation.[200] However, regulation should not be promulgated unless a particular concern is noted, and that concern cannot be addressed dynamically through the marketplace and soft law. In the AI field, there are 3 areas where hard regulation is likely the only possible approach namely:

a) AI systems themselves are generally considered software. These systems are governed and protected by copyrights and patents, and these are covered by a regulated area.

b) A legal regime that promotes investment focuses on technology transfer and sharing, protects intellectual property, and mandates accountability. These are important and fall under a regulated area.[201]

c) Unfair competition and other legal regimes are also available to govern the use of AI systems. This is an already regulated area and depends on robust government enforcement mechanisms which may need to be built or enhanced. The soft approach to regulation of AI technology.

Regulatory Sandboxes: Regulatory Sandboxes establish a controlled environment to test innovative technologies for a limited time based on a testing plan agreed upon with the competent authorities. These are similar to those already adopted in the financial services sector. They support responsible innovation and timely evolution of governance and legislation to ensure safeguards and balance competing rights and interests. For example, the EU AI Act proposes using AI regulatory sandboxes to provide an innovation-friendly and future-proof legal framework.[202] Mauritius also set up a regulatory sandbox licence to accommodate AI activities where that may have no or no adequate provisions in the existing regulatory framework.[203]

6.3.2.2 LESSONS FROM OTHER JURISDICTIONS – AI GOVERNANCE

This section reviews three AI governance frameworks that have a mix of hard and soft regulations and these include the EU AI Act (EU AIA) of 2021. The proposed US Algorithmic Accountability Act (US AAA) of 2022, and Singapore's Model AI governance framework.

The EU AI Act (EU AIA) of 2021[204] follows a risk-based approach, differentiating between uses of AI systems categories into three:

a) Prohibited, with unacceptable risk.
b) High risk.
c) Non-high risk, with low or minimal risk.

The AI Act considers a governance approach in which only the high-risk AI systems are regulated (or have a regulatory framework), and the non-high-risk AI systems follow a code of conduct. However, the code of conduct encourages non-high-risk AI systems to voluntarily apply the mandatory requirements for high-risk AI systems. The EU Commission chose this policy approach after evaluating four options against economic and societal impacts, including on fundamental rights. A list of high-risk

[200] Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification: http://proceedings.mlr.press/v81/buolamwini18a/buolamwini18a.pdf.
[201] https://africaaiaccelerator.com.
[202] EU AI Act 2021 https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF.
[203] Mauritius 2018, The Mauritius Artificial Strategy, https://ncb.govmu.org/ncb/strategicplans/MauritiusAIStrategy2018.pdf.
[204] EU AI Act 2021 https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF.

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AI systems will be maintained and occasionally updated as new high-risk systems. These will be identified after the prediction application of a set of criteria and risk assessment methodology.

The proposed US Algorithmic Accountability Act (US AAA) of 2022[205], aims to balance the benefits and risks of automated decision systems (ADS) and is a legislative effort to complement or replace self-regulation. US AAA will require organisations to perform impact assessments of; (i) ADS before deployment, and (ii) augmented decision-making processes after the deployment of ADS[206]. The regulation only targets organisations that employ ADS to make critical decisions and large companies that either:

a) Have an annual turnover of over US$50 million.
b) Have over US$250 million in equity value.
c) Process the information of over 1 million users.

Singapore's Model AI Governance Framework[207] adopted an approach of the Model AI Governance Framework or "Model Framework". The assumption is that if ethical principles can be translated into practice at the organisational level by following recommendations from the model framework, organisations can readily adopt to deploy AI responsibly. Its first version was in 2019, and a second version was released in 2020. In this version, each section has industrial examples to illustrate how organisations have implemented AI governance practices. In addition, organisations use an Implementation and Self-Assessment Guide for Organisations (ISAGO) to assess the alignment of their AI governance practices with the Model Framework.

ISAGO was developed in collaboration with the World Economic Forum centre of the Fourth Industrial Revolution. The model framework integrates the risks approach in determining the level of human involvement in AI – Augmented decision-making. They define three levels of human oversight, with a level chosen after a risk impact assessment that gives clarity and confidence in using an AI solution for a proposed purpose. These include Human-in-the-loop, which calls for active oversight, with AI only providing recommendations, but a human takes the final decision. There is also the Human-out-of-the-loop, in which no human oversight is required - low severity and low probability. Finally, there is the Human-over-the-loop (or human-on-the-loop) human oversight plays a monitoring or supervisory role, with the ability to take over control in case of model failure.

The three AI governance regimes, namely, EU AIA, US AAA, and the model framework that were highlighted above are attempts towards ensuring that ethical AI principles are translated into practical mechanisms to protect citizens from the possible harms of AI. Both the EU AIA and US AAA are examples of hard regulatory approaches. However, these can only cover part of the AI systems spectrum as EU AIA is meant to regulate only high-risk AI. In contrast, the US AAA is only meant for ADS to make critical decisions and target only large companies. The model framework is an example of a soft regulation that provides guidelines to help all organisations engaged with AI systems voluntarily translate AI principles into practice. On the other hand, Singapore has attempted to strike a balance between encouraging adoption and preserving public trust by taking a sector-specific approach guided by overarching guidelines. That is the Model Framework and subsequently studying the potential longer-term issues such as through the Research Programme and the Advisory Council.[208]

6.3.2.3 COST OF REGULATION NEED FOR PROMOTION OF SELF-REGULATION

[205] The US Algorithmic Accountability Act (US AAA) of 2022 https://www.congress.gov/117/bills/hr6580/BILLS-117hr6580ih.pdf.
[206] The US Algorithmic Accountability Act of 2022 vs. The EU Artificial Intelligence Act: what can they learn from each other? https://doi.org/10.1007/s11023-022-09612-y.
[207]Singapore's Model Artificial Intelligence governance framework (2020) 2nd Edition https://www.pdpc.gov.sg/-/media/files/pdpc/pdf-files/resource-for-organisation/ai/sgmodelaigovframework2.ashx.
[208]https://medium.com/digital-asia-ii/mapping-singapores-journey-and-approach-to-ai-governance-d01f76bbf5c6.

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AI is becoming increasingly sophisticated and is often embedded in other systems to enhance their capabilities or provide new functionalities. AI comes in 'all sizes and shapes' and is to play an even more significant role in our lives. The need for governing AI systems to ensure their safe and ethical use has become increasingly urgent, but there are high costs associated with this governance. There are several measures that different jurisdictions have taken to reduce these costs.

The European Union has developed a risk-based approach focusing on high-risk applications of AI that pose the most significant potential harm to individuals or society. This approach aims to avoid unnecessary regulatory burdens on low-risk applications of AI. Additionally, there is a need to encourage self-regulation by industry, in which companies develop their ethical guidelines and practices for AI development and deployment.

The implementation of effective self-regulation and industry standards can significantly diminish the necessity for extensive government intervention and regulatory oversight, thereby offering potential cost reductions for both industry players and regulatory bodies. When industries proactively establish self-regulatory measures, such as ethical guidelines, best practices, and transparent accountability mechanisms, they demonstrate a commitment to responsible conduct and safeguarding public interests. This proactive approach encourages industry stakeholders to take ownership of their actions and align their practices with societal expectations, reducing the burden on government regulators. Consequently, regulators can focus their resources on monitoring compliance, addressing critical issues, and fostering innovation, while industries can operate more efficiently and with greater autonomy within the boundaries of established self-regulatory frameworks. This collaborative approach fosters a balance between industry freedom and necessary oversight, leading to streamlined processes, improved trust, and potentially lower costs for all involved parties.

For example, the Singapore Model AI Governance Framework was developed by the government in collaboration with industry experts and aimed to guide organisations in the responsible and ethical development and deployment of AI. This framework encourages self-regulation by promoting a culture of responsible AI development and deployment while minimising the need for government intervention or regulation. This approach reduces compliance costs for organisations while fostering innovation and growth in the AI sector. [209]

The framework includes several components, one of which is the principle of "Responsibility," which emphasises the importance of organisations taking responsibility for developing and using their AI systems. This component includes developing and implementing internal policies and processes to ensure the responsible and ethical use of that AI system.

The framework also encourages organisations to adopt a "risk management" approach to AI governance, in which risks associated with using AI systems are identified, assessed, and managed through appropriate measures such as internal controls, monitoring, and review processes. This approach enables organisations to minimise the risks associated with AI and ensure that AI is used in a way consistent with ethical and social norms.

Self-regulation by industry stakeholders can also play a role in promoting responsible and ethical AI development and deployment in countries without specific AI governance regulations. Industry associations and organisations can develop their ethical guidelines and best practices for AI, promoting a culture of responsible AI use and potentially reducing the need for government intervention or regulation.[210]

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[209] Infocomm Media Development Authority (IMDA) of Singapore (2019), "Model AI Governance Framework", available at https://www.imda.gov.sg/-/media/Imda/Files/Industry-Development/Artificial-Intelligence/AIGovernanceFramework.pdf

[210] Mauritius Information and Communication Technologies Authority (ICTA) (2019), "Mauritius AI Strategy Development Workshop",

6.3.3 DATA POLICIES AND GOVERNANCE

Data is a crucial component for building AI systems. Always vast amounts of quality data (that is accurate, complete, relevant, and unbiased) are required for building responsible AI systems to benefit but not harm (or discriminate against) any individual or group. The accountable and safe access to such data requires conducive policies and regulations to enable a solid and sustainable data ecosystem that supports AI development and deployment while ensuring data protection and privacy. These policies and regulations include data protection and privacy law, cybersecurity, and the national data strategy.

Data protection and privacy law: Currently, 33 countries have data protection legislation that somehow addresses automated decision-making. Just over half of African countries have enacted privacy laws and policies. Moreso, the African Union Convention on Cybersecurity and Personal Data Protection, has been signed by 14 countries, and only eight countries ratified it by June 2020. Despite significant progress made in the regulation of data protection on the continent in recent years, UNESCO has noted that:

"These legal provisions may need to be updated to the new uses and applications of data engendered by AI to offset biases and discriminations, including based on race and gender, or loss of personal privacy through predictive analysis among others."

Thus, African governments should enact data protection and cyber security laws to protect human rights and privacy while harnessing the benefits of AI. Beyond data governance and personal data protection, legal protection against algorithmic bias and discrimination is needed, and this calls for full-fledged AI governance.

Cybersecurity laws establish legal frameworks to protect individuals, organisations, and governments from cyber threats and attacks. AI systems, just like any other computer system, are vulnerable to cyber threats. However, AI systems are at higher risk of cyber threats because of the large amounts of data and complex algorithms that create new attack vectors for cybercriminals to exploit. Examples of cybersecurity laws include Algeria's Cybercrime Law 2015 and Kenya's Computer Misuse and Cybercrimes Act 2018.

6.3.4 NATIONAL DATA STRATEGY

A National Data Strategy sets out a vision and plans how a country intends to maximize benefits from data generated within and outside government as a resource. It ensures the effective use of data to drive innovation, economic growth, and social benefits while protecting individual privacy, data security, and ethical considerations. It provided for strategies to improve data quality, share data across agencies, and promote data-driven decision-making in government policy.

Several countries, including the United Kingdom, Canada, and Australia, have developed National Data Strategies to guide their data governance efforts. For example, the United Kingdom's National Data Strategy, launched in 2020, focuses on developing a world-leading data economy that works for everyone. The strategy aims to promote ethical and responsible data use, increase public trust in data use, and ensure the use of data to drive economic growth and social benefits. It includes measures to improve data skills and literacy, promote data sharing and interoperability, and develop innovative data-driven technologies.

Similarly, Canada's Data Strategy, launched in 2018, focuses on promoting responsible data use, strengthening privacy protections, and fostering a data-driven culture. In addition, the strategy includes measures to promote open data, increase public access to data, and develop data infrastructure to support innovation and economic growth. Only Nigeria in Africa has a draft national data strategy, and Uganda has started the process. With the AU data policy framework, African countries can develop their national data strategies by attempting to domesticate the framework at the national level.

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6.3.5 COMMERCE AND INNOVATION POLICIES

Innovation and business policies and regulations can have an impact on the development and deployment of AI technologies. Here are some examples of policies and regulations that relate to innovation and business and could relate to the governance of AI.

6.3.5.1 LAWS (IMPACTED LAWS)

Competition law: Competition law is an essential regulatory instrument to safeguard market competition, promote innovation and protect consumer interests. However, with the adoption of AI, there are concerns about competition harms that might stem from collusion, abusive conduct on the part of dominant firms, or mergers. The nature of these outcomes may be challenging to address using existing competition enforcement tools. Thus, each African country should revise the existing competition tools to incorporate the unfair competition that might arise from using AI.

Liability law: As AI grows, Brookings estimates that the volume of products and services incorporating AI will be enormous, and so will the potential for software-induced harm. The laws of statistics ensure that even if AI does the right thing nearly all the time, there will be instances where it fails. While some failures may be benign, others could harm persons or property. When that occurs, questions of attribution and remedies will arise. Whose fault is it if an AI algorithm makes a decision that causes harm? How should a defect be identified and apportioned? What kind of remedy to set? What measures should be imposed to ensure the non-recurrence of mistakes in future?

For example, the EU Liability law deals with risks and damage sustained from using (consumer) products, whether derived from new technologies or not. Therefore, it is essential to establish who is liable for which aspects of AI in the African context. Relatedly, allocating strict and tort liabilities sets the scene for a perfect AI environment, including insurance and litigation. This can help African countries deal with African cases of AI innovation and advancements.

Patent and Intellectual Property: Protection of Intellectual Property (IP) may be considered one of the major contributing factors to the delay or reluctance to implement AI Technology. In the absence of assurances, policies and regulations that can ensure that the innovator's developers' work will be protected, innovators and developers of AI technology may be reluctant to drive the need for the implementation of such a technology. IP rights should be afforded the same protection as any fundamental human right if the African continent is to be successful in deploying and reaping the benefits that are inherent in the use of AI technology.

IP plays a crucial role in the development and success of businesses by providing incentives for inventiveness and creativity while fostering innovation. Through mechanisms such as patents, trademarks, copyrights, and trade secrets, IP rewards individuals and organisations for their original ideas and creations. This rewards system encourages innovators, entrepreneurs, researchers, and artists to invest time, resources, and effort into developing new products, technologies, and artistic works. By granting exclusive rights to the IP holder, IP protection safeguards these assets from unauthorised use or exploitation, thus providing a competitive advantage in the market. Moreover, IP also facilitates collaboration and the sharing of knowledge and expertise, as it allows businesses to establish licensing agreements, joint ventures, and partnerships, fostering further innovation and business growth. Overall, IP serves as a crucial foundation for building successful businesses, promoting investment, protecting assets, and fostering a culture of innovation and knowledge exchange.

Governments across the African continent should embrace and encourage the development and usage of AI technology through policies and strategies specifically aimed at the protection of IP. This can be accomplished through joint initiatives with agencies such as the World Intellectual Property Organisation (WIPO) and the soon-to-be-established Pan African Intellectual Property Organisation (PAIPO). PAIPO was established primarily to implement AU policy in the field of Intellectual property.

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This body will ensure the dissemination of patent information, provide technical and financial support to invention and innovation, and promote the protection and exploitation of research results.

6.3.5.2 EXAMPLES FROM OTHER JURISDICTIONS

Establishing a well-coordinated intellectual property regulatory system for Africa's AI-enabling environment holds numerous benefits and advantages. These benefits include:

a) Encouraging Innovation and Creativity: A robust intellectual property framework encourages innovation, creativity, and inventiveness. By protecting the rights of innovators and creators, it provides a secure environment for them to develop and share their AI technologies. This protection incentivises individuals and organisations to invest in research and development, leading to continuous advancements in the field of AI.
b) Protection of Assets: An effective intellectual property system safeguards valuable assets and investments made in AI. It provides legal mechanisms to protect inventions, algorithms, software, and other intellectual property assets related to AI. This protection encourages businesses and entrepreneurs to pursue AI initiatives, as they have the assurance that their intellectual property rights will be respected and safeguarded.
c) Supporting Startup Business Growth: A well-coordinated intellectual property regulatory system supports the growth of startup businesses in the AI sector. Start-up companies often rely on their intellectual property as a key asset, and a robust IP framework provides them with the means to protect and commercialize their innovations. This support fosters a favourable environment for start-up companies to thrive, attract funding, and contribute to the overall growth of the AI ecosystem in Africa.
d) Promoting Healthy Competition: An effective intellectual property system encourages healthy competition within the private sector. It ensures fair and transparent rules for IP protection, preventing monopolies and promoting a competitive landscape. This competition drives innovation and leads to wider availability of AI technologies across different sectors, benefiting businesses, organisations, and individuals alike.
e) Facilitating Knowledge Sharing: A well-structured intellectual property framework encourages knowledge sharing without the fear of IP infringements. It provides mechanisms such as licensing and collaborative agreements that enable the exchange of ideas, technologies, and expertise among stakeholders. This promotes collaboration, accelerates AI advancements, and allows for cross-pollination of knowledge and best practices.

Therefore, a well-coordinated intellectual property regulatory system in Africa's AI-enabling environment serves as a catalyst for innovation, protects valuable assets, supports startup growth, fosters healthy competition, and facilitates knowledge sharing. By establishing and enforcing such a system, Africa can create an environment conducive to AI development, attract investments, and propel the continent towards becoming a hub for AI innovation and adoption.

6.3.6 SINGAPORE'S AI IP STRATEGY:

To support companies in Singapore, the Intellectual Property Office of Singapore (IPOS) has taken proactive measures to facilitate AI innovation and commercialisation. They have established IPOS International, an enterprise engagement arm that offers tailored AI solutions and programmes to companies. This initiative aims to provide companies with the necessary support and resources to navigate the complex landscape of AI.

As part of their National AI Strategy, the Singaporean Government has recognized the importance of intellectual property (IP) legislation in fostering AI development and commercialisation. They have committed to reviewing their current IP laws to ensure they are conducive to supporting the advancement and deployment of new AI technologies. This strategic approach acknowledges the unique challenges and opportunities posed by AI and aims to create a regulatory framework that promotes innovation while safeguarding the rights of innovators and creators.

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Having clear legislation specific to AI is crucial as it provides certainty for AI innovators when commercializing their products and services. The clarity in IP laws enables innovators to understand their rights, protect their inventions, and effectively monetize their AI technologies. It also fosters a favourable business environment, encouraging investment in AI research and development.

Regarding patents on AI and AI outputs, it's important to note that AI heavily relies on software and data. While software, in most cases, may not be eligible for patent protection, it can still be protected by copyright and trade secrets. However, in certain instances, computer-implemented inventions (CIIs) related to AI may be eligible for patent protection if they meet specific requirements. This recognition highlights the need to navigate the legal landscape and explore the most appropriate forms of IP protection for AI innovations. Therefore, by addressing these aspects and aligning IP legislation with the unique characteristics of AI, Singapore aims to provide a supportive environment for AI companies to thrive, fostering innovation, and driving economic growth in the AI sector.

A recent EPO study notes that AI has been one of the fastest-growing Fourth Industrial Revolution 19 (4IR) fields since 2011, with an average annual growth rate of 43% and 83 patent applications in 2016 (EPO, 2017). However, the increased pace of patent applications is confronted with several legal uncertainties. The legal uncertainties inherent in patent applications for AI outputs or inventions made by AI systems are evidenced in the below case study:

Case Study:

The South African Companies and Intellectual Property Commission (CIPC) made history in 2021 by becoming the first patent office in the world to grant a patent listing an artificial intelligence, rather than a human being, as the inventor. In this instance, the developer of the AI, Dr Stephen Thaler was the patentee.

The patent lists “Dabus” as the inventor and notes that “the invention was autonomously generated by an artificial intelligence”. Dabus is an acronym for “Device for the Autonomous Bootstrapping of Unified Sentience”.

The AI developer, Thaler launched similar applications in other jurisdictions such as the US, the EU, the UK, Germany, New Zealand, Taiwan, India, Korea, Israel, and Australia, all of which have so far been rejected, mainly on the basis that a natural person should be listed as an inventor.

Whilst the application for Dabus was successful in South Africa, the sentiment surrounding the application has been less than enthusiastic with courts around the world reluctant to grant Thaler’s application to patent Dabus.

Whilst the current patent legislation in South Africa does not contemplate AI being regarded as an inventor, the patent application for Dabus was successful in South Africa because South Africa does not offer formal examination and instead requires applicants to merely complete a filing for their invention.

The overarching basis for the reluctance to approve the application appears to be the fact that AI systems in jurisdictions outside of South Africa cannot be deemed to be an inventor.

Takeaway points:

a) Various jurisdictions employ different modes of considering patent applications.

b) There is a need not only globally but in Africa to ensure there is a standardisation of policies and considerations in AI patent applications.

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Creating and protecting Intellectual Property: The Intellectual Property Office Singapore (IPOS) recognises that AI researchers and developers need the right support to commercialise their IP. Thus, the IPO office can help them to understand and identify their intellectual assets and provide them with the skills to protect them. This can enable them to exploit and enforce their rights to improve their chances of survival and growth.[211]

6.4 THE PAN AFRICAN INTELLECTUAL PROPERTY ORGANISATION (PAIPO)

The PAIPO is a regional intellectual property organisation that was established in 2007 by the African Union (AU). Its mission is to promote the development and protection of intellectual property (IP) rights in Africa. PAIPO has 17 Member States, including South Africa, Nigeria, Kenya, and Ethiopia. In 2023, PAIPO is expected to launch a new IP policy framework for Africa. The framework will guide how to use IP to promote economic growth, social development, and innovation in Africa. PAIPO is also expected to launch a new IP training program for African professionals. The program will provide training on how to register and enforce IP rights in Africa.

The establishment of PAIPO has the potential to have several positive impacts on Africa. These impacts include:

a) Increased investment in innovation. By providing a regional platform for IP registration and enforcement, PAIPO can help to attract more investment in innovation in Africa.
b) Improved access to technology. By providing a regional platform for IP registration and enforcement, PAIPO can help to improve access to technology in Africa.
c) Increased economic growth. By promoting innovation and access to technology, PAIPO can help to increase economic growth in Africa.
d) Improved social development. By promoting innovation and access to technology, PAIPO can help to improve social development in Africa.

In general, the establishment of PAIPO is a positive development for Africa. PAIPO has the potential to play a key role in promoting innovation, access to technology, and economic growth in Africa.

Here are some specific examples of how PAIPO could impact African countries as of June 2023:

a) PAIPO could help African countries to attract more investment in innovation. By providing a regional platform for IP registration and enforcement, PAIPO could make it easier for businesses to protect their IP rights in Africa. This could make Africa a more attractive destination for investment in innovation.
b) PAIPO could help African countries to improve access to technology. By providing a regional platform for IP registration and enforcement, PAIPO could make it easier for businesses to bring new technologies to market in Africa. This could improve access to technology for African businesses and consumers.
c) PAIPO could help African countries to increase economic growth. By promoting innovation and access to technology, PAIPO could help to increase economic growth in Africa. This could lead to job creation, increased productivity, and improved living standards for African citizens.
d) PAIPO could help African countries to improve social development. By promoting innovation and access to technology, PAIPO could help to improve social development in Africa. This could lead to improved healthcare, education, and other social services for African citizens.

[211] United Kingdom 2021, National AI Strategy, https://www.pdpc.gov.sg/-/media/files/pdpc/pdf-files/resource-for-organisation/ai/sgmodelaigovframework2.ashx.

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Generally, PAIPO has the potential to be a valuable resource for African countries in 2023 and beyond. By promoting innovation, access to technology, and economic growth, PAIPO can help to improve the lives of millions of Africans.

6.4.1 REVIEW OF EXISTING FRAMEWORKS RELATED TO AI IN AFRICA

Here is a review of some of the existing frameworks related to AI in Africa:

a) The African Union's Framework on Artificial Intelligence (2019): This framework guides how to develop and use AI in Africa responsibly and ethically. It covers a wide range of issues, including data protection, privacy, bias, and job displacement.
b) The UNESCO AI for Africa Strategy (2020): This strategy aims to support the use of AI to improve education, healthcare, and other social services in Africa. It also aims to promote the development of African AI talent and the responsible use of AI in Africa.
c) The World Economic Forum's Africa Artificial Intelligence Council (2021): This council brings together leaders from government, business, and academia to discuss the future of AI in Africa. It aims to develop policies and initiatives to help Africa reap the benefits of AI while mitigating its risks.
d) The Rockefeller Foundation's AI for Social Impact in Africa Initiative (2022): This initiative aims to use AI to address some of Africa's most pressing social challenges, such as poverty, inequality, and climate change. It provides funding and technical support to African organisations that are developing AI-powered solutions to these challenges.

These are just a few of the existing frameworks related to AI in Africa. Many other frameworks are being developed or implemented across the continent. These frameworks can guide how to develop and use AI responsibly and ethically, and they can help to ensure that AI is used to benefit the people of Africa.

6.4.2 AI ETHICS, LEGAL FRAMEWORKS, AND REGULATIONS

Currently, Africa is at a pivotal intellectual property (IP) moment as the continent is preparing for the second phase of the African Continental Free Trade Area (AfCFTA) negotiations. These are covering investment, competition, and IP as inspired by the Pan-African vision of an “integrated, prosperous, and peaceful Africa”, as expressed in the AU Agenda 2063 to promote sustainable socioeconomic development. So far, 44 African countries have signed the Agreement Establishing the AfCFTA on 21 March 2018 at the 10th Extraordinary Session of the Assembly of the AU in Kigali, Rwanda.1Effective from 30 May 2019, the AfCFTA is the world’s largest continental free trade area, creating a single market for goods and services that apply to 1.2 billion people, projected to expand to 2.5 billion by 2050. Article 8 of the Agreement Establishing the AfCFTA provides that the Protocols on Trade in Goods, Trade in Services, Investment, IP Rights, Competition Policy, Rules and Procedures on the Settlement of Disputes and their associated Annexes and Appendices will form an integral part of the AfCFTA as a single undertaking.2Thus, similar to the World Trade Organisation (WTO), AfCFTA Member States cannot pick and choose which Protocols, Annexes and Appendices to adopt and which to abandon.3Member States are bound to fulfil obligations set out under all the Protocols.

Accordingly, to avoid the pitfalls of Phase I AfCFTA negotiations especially the uncritical adoption of the Dispute Settlement template of the WTO, I argue that the negotiators need to carefully contour the IP Protocol to fit the African context for which it is introduced. This requires designing homegrown IP systems that underscore the unique forms of innovation and creativity in Africa to deliver an effective development-oriented IP Protocol. One of the core conundrums for the IP Protocol negotiators to confront is the fragmented IP architecture on the continent, comprising an array of partially overlapping

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and sometimes conflicting agreements, laws, policies, and sub-regional organisations that I refer to as the regime complex for IP in Africa.

Africa's fragmented IP architecture alongside the sharp disconnect between regional aspirations and sub-regional realities is shaped by external influences such as bilateral/regional/multilateral trade agreements and colonial/coercive pressures. This combination of factors materially contributes to the policy incoherence and inconsistency of IP regimes on the continent. I contend that the AfCFTA IP Protocol has a novel opportunity to address this fragmentation.

The prevalent forms of innovation and creativity in Africa are grounded in indigenous low-cost technologies in informal sectors such as agriculture, the mainstay of most African economies and entertainment, a nascent contributor to African economies. This does not disregard Africa's emerging digital ecosystem sparked by the ubiquity of mobile phones and the influx of high-speed internet across the continent from the early 2000s. The vibrant class of innovators and digital entrepreneurs, clustered in technology hubs modelled after Silicon Valley, such as 'Silicon Savannah' in Nairobi, Kenya and 'Yabacon Valley' in Lagos, Nigeria are developing cutting-edge technologies applicable to both the informal and formal sectors.

Contextually appropriate IP systems in Africa, therefore, would consider and respond to the unique innovation and creativity scene on the continent, to ensure that IP is employed as a tool to stimulate social and economic development. In doing so, it would be imperative to design the different categories of IP, namely copyright and related rights; industrial property (including patents, trademarks, industrial designs, and geographical indications-GIs); and sui generis rights (including plant variety protection, traditional knowledge, and traditional cultural expressions), in line with the exigencies, realities and priorities on the continent. In particular, Africa's rich agricultural resources, traditional knowledge and cultural repositories afford it comparative advantages with GIs, plant variety protection, traditional knowledge, and traditional cultural expressions.

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6.4.3 AI REGULATORY FRAMEWORK

AI is rapidly developing and has the potential to revolutionize many aspects of life in Africa. However, there are also risks associated with AI, such as bias, discrimination, and job displacement. An AI regulatory framework can help to mitigate these risks and ensure that AI is used responsibly and ethically.

An AI regulatory framework can help to address the following issues:

a) Data protection: AI systems often require large amounts of data to train and operate. An AI regulatory framework can help to ensure that this data is collected and used responsibly, and that individuals' privacy is protected.
b) Bias: AI systems can be biased, which can lead to unfair or discriminatory outcomes. An AI regulatory framework can help to address this issue by requiring that AI systems be transparent and accountable and that they are not used to discriminate against individuals or groups.
c) Job displacement: AI systems can automate tasks that are currently performed by humans. This could lead to job displacement, which can hurt individuals and communities. An AI regulatory framework can help to mitigate this impact by providing retraining and other support to individuals who are displaced by AI.

An AI regulatory framework is an important tool for ensuring that AI is used responsibly and ethically in Africa. By addressing the issues of data protection, bias, and job displacement, an AI regulatory framework can help to ensure that AI benefits all Africans, and not just a select few.

Here is a brief overview of the AI regulatory framework in Africa:

a) The African Union (AU) has developed a Framework for Artificial Intelligence (2019). This framework can guide African countries on how to develop and use AI responsibly and ethically. It covers a wide range of issues, including data protection, privacy, bias, and job displacement.
b) Several African countries have developed their own AI regulations. For example, Kenya has a Data Protection Act (2019) that regulates the collection, use, and sharing of personal data. Nigeria has a National Artificial Intelligence Policy (2020) that sets out the government's vision for the development and use of AI in Nigeria.
c) Several international organisations are working on AI regulations. For example, the World Economic Forum has developed a Global AI Council (2019) that is working to develop global governance principles for AI. The United Nations has developed a Roadmap for Responsible AI (2020) that sets out several recommendations for the responsible development and use of AI.

The AI regulatory framework in Africa is still in its early stages of development. However, there is a growing consensus that AI needs to be regulated to ensure that it is used responsibly and ethically. The frameworks that are being developed are based on the principles of transparency, accountability, fairness, and non-discrimination. These principles are essential for ensuring that AI is used to benefit society and not harm.

Here are some of the challenges that African countries face in implementing AI regulations:

a) Lack of resources: Many African countries lack the resources to implement AI regulations. They may not have the financial resources to hire lawyers and consultants to draft and implement regulations, or the human resources to enforce regulations.
b) Lack of data: Many African countries lack the data that is needed to assess the risks and benefits of AI. This is a major challenge for the development of AI regulations.
c) Lack of expertise: Many African countries lack the expertise that is needed to develop and enforce AI regulations. This is a major challenge for the adoption of AI regulations.

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Despite these challenges, there is a growing interest in AI regulations in Africa. African governments, businesses, and universities are increasingly investing in AI research and development. This is a positive development, and AI regulations will likely play a major role in Africa's future.

Here are some of the potential benefits of AI regulations:

a) Increased trust in AI: AI regulations can help to increase trust in AI by ensuring that it is used responsibly and ethically.
b) Improved safety: AI regulations can help to improve the safety of AI by ensuring that it is not used to harm people or property.
c) Increased innovation: AI regulations can help to increase innovation by providing a clear framework for the development and use of AI.
d) Protected rights: AI regulations can help to protect the rights of individuals, such as their right to privacy and their right to be free from discrimination.

AI regulations have the potential to serve as a valuable tool for ensuring the responsible and ethical use of AI in Africa. These regulations can establish clear guidelines and standards that govern the development, deployment, and usage of AI technologies. By promoting transparency, accountability, and fairness, regulations can mitigate the risks associated with AI, such as bias, privacy infringement, and job displacement. They can also address ethical considerations, including the protection of human rights and the prevention of AI misuse. Implementing robust regulations will not only foster trust among users and stakeholders but also attract investment and encourage the development of AI solutions that have a positive socioeconomic impact in Africa. Ultimately, AI regulations can shape a sustainable and inclusive AI ecosystem in Africa, where AI technologies are harnessed for the benefit of society while minimizing potential harm.

6.5 MECHANISMS FOR AI GOVERNANCE

This section discusses some policy mechanisms and interventions that African countries have identified in the governance of AI. These mechanisms and interventions include data literacy and digital competence, sectoral self-regulation, standards, and certification schemes. Further to this, the mechanisms and interventions include statutory regulation and enforcement, regulatory sandbox initiatives, and AI ethics boards.

6.5.1 DATA LITERACY AND DIGITAL COMPETENCE

Several countries, especially in Africa, have a low level of awareness and education about AI technology and its benefits and risks. Hence, a skills gap in AI development and deployment is observed within these countries. Worth noting is that AI does not exist in a vacuum, however, its competencies are built on broader data and digital literacy foundations. Therefore, African countries should pursue data literacy and digital competence across all economic sectors to enhance the assimilation of AI in their systems.

Other jurisdictions have identified initiatives around awareness, literacy, and talent development. These include African countries such as Egypt, that have introduced AI ethics courses in AI degrees. Further to this, Egypt is also training AI practitioners in AI Ethics. On the other hand, the UK has launched a Centre for Data Ethics and Innovation to enhance data literacy and digital competence. South Korea is developing AI ethics education curriculums for students, developers, and general citizens. Data literacy and digital competence efforts should be geared towards technical skills and social aspects of building trust in AI and associated technologies.

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6.5.2 SECTOR SELF REGULATION

Self-regulation is important in guiding the appropriate action in the absence of, or in anticipation of, statutory controls. Self-regulation is undertaken through sectoral codes of conduct or industry standard practices. This mechanism is more responsive to societal and technological changes than a formalised standard or statutory regulation, which can take time to develop and may entail significant procedural hurdles. The reason is that self-regulation reduces the scope of ethical principles to translate into actional ethical practices. This is because of the specific nature of AI applications in the given sector. Furthermore, self-regulation also allows for the amendment of current regulations in the industry to cater to new aspects introduced by an AI application.[212]

Examples of sectoral self-regulations are in the case of Mauritius in the perspective of increasing the capacity of existing Ethics Committees in the Health Sector.[213] There is also the National AI Strategy in India that advocates for domain-specific ethical councils to aid in developing sector-specific guidelines on privacy, ethics, and security.[214] Further to this, in 2018, the UK government adopted the sectoral approach as they found it more appropriate. However, their new National AI strategy[215] has also proposed some cross-sectoral approaches. This was mainly because there are overlaps between specific regulations and inconsistent approaches across sectors. Examples of the areas proposed under cross-sectoral include data protection and human rights and equity, and those under sectoral are financial services and medical products. Their first take on the sectoral approach allowed them to identify areas requiring a cross-sectoral approach.

6.5.3 STANDARDS AND CERTIFICATIONS SCHEMES

Standards and Certification Schemes provide objective and transparent benchmarks for organisations and processes to be assessed against; This requires well-laid-out standards, assessments, and a certification body that issues certificates after carrying out checks or verifying self-assessments.[216] The EU AI Act requires high-risk AI systems to undergo conformity assessment before being given a certificate in the European Union.[217]

6.5.4 STATUTORY REGULATION AND ENFORCEMENT

Regulation of AI should be adaptable to the ever-changing landscape of emerging technology. Thus, a blanket approach to the regulation of AI and enforcement of rules, standards and/or ethical guidelines is unlikely to yield an advantageous mode of AI regulation. The regulation of AI may on a broad scale be categorised into two main categories, hard and soft regulation.[218] However, regulation should not be promulgated unless a particular concern is noted, and that concern cannot be addressed dynamically through the marketplace and soft law. In the AI field, there are 3 areas where hard regulation is likely the only possible approach namely:

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[212] https://deeplearningindaba.com/2022/.

[213] Mauritius 2018, The Mauritius Artificial Strategy, https://ncb.govmu.org/ncb/strategicplans/MauritiusAIStrategy2018.pdf.

[214] The US Algorithmic Accountability Act (US AAA) of 2022 https://www.congress.gov/117/bills/hr6580/BILLS-117hr6580ih.pdf.

[215] United Kingdom 2021, National AI Strategy, https://www.pdpc.gov.sg/-/media/files/pdpc/pdf-files/resource-for-organisation/ai/sgmodelaigovframework2.ashx.

[216] European Union 2018, National strategies on AI A European perspective, https://knowledge4policy.ec.europa.eu/sites/default/files/finland-ai-strategy-report.pdf

[217] EU AI Act 2021 https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF.

[218] Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification: http://proceedings.mlr.press/v81/buolamwini18a/buolamwini18a.pdf.

d) AI systems themselves are generally considered software. These systems are governed and protected by copyrights and patents, and these are covered by a regulated area.
e) A legal regime that promotes investment focuses on technology transfer and sharing, protects intellectual property, and mandates accountability. These are important and fall under a regulated area.[219]
f) Unfair competition and other legal regimes are also available to govern the use of AI systems. This is an already regulated area and depends on robust government enforcement mechanisms which may need to be built or enhanced. The soft approach to regulation of AI technology.

6.5.5 DATA AND AI ETHICS BOARD/ NATIONAL AI COUNCIL

Sometimes called the Ethics Council in India or Ethics Committee for the case of Mauritius, the board is composed of a team drawn from the government, academia, the private sector, and civil society the body can support the regulations through the provision of independent and unbiased expertise and insights. This board acts as a steward of the AI ethics principles and coordinates independent research into best practices and the standards for the ethical application of AI technology to benefit society. The ethics board may also have a lead role in the coordination and oversight of the regulatory sandboxes.[220]

In 2019, the Egyptian Government established the National AI Council which comprises representatives from Government, the private sector, and academics. AI governance at a national level in Africa is still in its early stages, but there is growing interest and momentum in the region. Some countries in Africa have established AI councils or task forces to explore the opportunities and challenges presented by AI and to develop policies and strategies to govern its development and use.

One of the key challenges in AI governance in Africa is the lack of capacity and resources to develop and implement effective policies and regulations. Many countries in Africa face significant economic and social challenges and may not have the resources or expertise to devote to AI governance. Additionally, there may be a lack of awareness and understanding of AI among policymakers and the general public, which can make it difficult to develop effective policies and regulations.[221]

Despite these challenges, there are also significant opportunities for AI in Africa, particularly in areas such as healthcare, agriculture, and financial services. AI can help improve access to healthcare in remote areas, increase agricultural productivity, and expand financial inclusion, among other benefits.

Establishing national AI councils can have several important benefits:

a) Coordination and collaboration: AI councils can bring together experts and stakeholders from different sectors and organisations to coordinate and collaborate on AI-related policies and initiatives. This can help avoid duplication of effort and ensure that resources are used effectively.
b) Ethics and regulation: AI councils can guide ethical considerations and help develop regulations to ensure that AI is used responsibly and for the benefit of society as a whole. This can help address concerns around privacy, bias, and accountability.
c) Innovation and competitiveness: AI councils can help drive innovation by fostering partnerships between academia, industry, and government, and promoting research and development in AI-related fields. This can help countries maintain competitiveness and create new economic opportunities.

[219] https://africaaiaccelerator.com.
[220] India 2018, National Strategy for AI #AIFORALL, https://indiaai.gov.in/documents/pdf/NationalStrategy-for-AI-Discussion-Paper.pdf
[221] Hungary 2020, Hungary's AI Strategy, https://ai-hungary.com/files/e8/dd/e8dd79bd380a40c9890dd2fb01dd771b.pdf

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d) Education and workforce development: AI councils can help identify the skills and training needed to develop a workforce capable of working with and developing AI technology. This can help ensure that people have the skills needed to participate in the AI-driven economy.

6.5.6 THE FUNCTIONS OF NATIONAL AI COUNCILS

The functions of National AI councils can vary depending on the country and its specific needs, but here are some common functions that these councils may serve:

a) Policy Development: National AI councils can develop policies and guidelines for the development, deployment, and regulation of AI in the country. This can include developing ethical guidelines for the use of AI, setting standards for AI development and deployment, and creating policies to ensure that AI is used in a way that benefits society.
b) Strategic Planning: National AI councils can develop long-term strategies for AI development in the country. This can include identifying key areas where AI can have the greatest impact, determining research and development priorities, and identifying potential challenges and risks associated with AI development.
c) Coordination and Collaboration: National AI councils can facilitate collaboration and coordination among stakeholders in the AI ecosystem. This can include bringing together researchers, policymakers, industry leaders, and civil society organisations to share knowledge, exchange ideas, and develop solutions to common challenges.
d) Capacity Building: National AI councils can support capacity-building initiatives to ensure that the country has the necessary skills and expertise to develop and deploy AI. This can include promoting STEM education, developing AI training programmes, and supporting AI research and development.
e) International Engagement: National AI councils can engage with international organisations and initiatives focused on AI governance to share best practices, learn from other countries experiences, and promote global collaboration on AI governance.

6.5.7 REGULATORY SANDBOXES

Regulatory Sandboxes establish a controlled environment to test innovative technologies for a limited time based on a testing plan agreed upon with the competent authorities. These are similar to those already adopted in the financial services sector. They support responsible innovation and timely evolution of governance and legislation to ensure safeguards and balance competing rights and interests. For example, the EU AI Act proposes using AI regulatory sandboxes to provide an innovation-friendly and future-proof legal framework.[222] Mauritius also set up a regulatory sandbox licence to accommodate AI activities where that may have no or no adequate provisions in the existing regulatory framework.[223]

Regulatory sandboxes are a type of regulatory framework that allows businesses to test innovative products and services in a controlled environment. This can help businesses to mitigate risks and get feedback from users before launching their products or services on a larger scale. Thus, regulatory sandboxes are becoming increasingly popular in Africa, as businesses and governments look for ways to encourage innovation and promote economic growth. In 2023, there are several regulatory sandboxes in operation in Africa, including:

[222] EU AI Act 2021 https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF.
[223] Mauritius 2018, The Mauritius Artificial Strategy, https://ncb.govmu.org/ncb/strategicplans/MauritiusAIStrategy2018.pdf.

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a) The Kenya Regulatory Sandbox: This sandbox was launched in 2019 by the Central Bank of Kenya (CBK). It allows businesses to test innovative financial products and services in a controlled environment.

b) The South African Regulatory Sandbox: This sandbox was launched in 2020 by the South African Reserve Bank (SARB). It allows businesses to test innovative financial products and services in a controlled environment.

c) The Mauritius Regulatory Sandbox: This sandbox was launched in 2021 by the Mauritius Financial Services Commission (FSC). It allows businesses to test innovative financial products and services in a controlled environment.

Regulatory sandboxes have the potential to have several positive impacts in Africa, including:

a) Encouraging innovation: Regulatory sandboxes can help to encourage innovation by providing businesses with a safe space to test new products and services. This can help businesses to develop new and innovative solutions to meet the needs of African consumers and businesses.

b) Promoting economic growth: Regulatory sandboxes can help to promote economic growth by encouraging businesses to invest in innovation. This can lead to the creation of new jobs and the development of new industries.

c) Improving access to financial services: Regulatory sandboxes can help to improve access to financial services by allowing businesses to test innovative financial products and services. This can help to reach underserved populations and reduce poverty.

Taken as a whole, regulatory sandboxes have the potential to be a valuable tool for promoting innovation and economic growth in Africa. By providing businesses with a safe space to test new products and services, regulatory sandboxes can help businesses to develop new and innovative solutions to meet the needs of African consumers and businesses. This can lead to the creation of new jobs, the development of new industries, and improved access to financial services.

Here are some additional details about regulatory sandboxes:

a) Regulatory sandboxes are typically open to a limited number of businesses. This is done to ensure that the sandbox is not overwhelmed and that businesses can receive feedback from regulators and users.

b) The length of time that businesses can participate in a regulatory sandbox varies. This is typically determined by the regulator and the nature of the product or service being tested.

c) Regulatory sandboxes are not without risks. Businesses that participate in a regulatory sandbox may face challenges such as regulatory uncertainty, limited access to funding, and competition from other businesses.

Despite the risks, regulatory sandboxes offer several potential benefits for businesses and regulators. By providing a safe space to test new products and services, regulatory sandboxes can help businesses to develop innovative solutions that meet the needs of consumers and businesses. This can lead to economic growth, job creation, and improved access to financial services.

6.5.8 PATENTS AND INTELLECTUAL PROPERTIES

Patents and intellectual property (IP) rights are important for the development of AI in Africa. They can help to protect the investments of businesses and researchers, and they can encourage innovation. There are several examples of how patents and IP rights are being used to promote AI in Africa. For example,

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the African Development Bank (AfDB) has launched an AI patent challenge to encourage the development of new AI technologies. The challenge will award prizes to the best AI patents that are submitted. Additionally, the AfDB is also working with African governments to develop national AI policies that include provisions for patents and IP rights. These policies will help to create a more favourable environment for the development and commercialisation of AI in Africa.

Patents and IP rights can have several positive impacts on the development of AI in Africa. They can help to:

a) Attract investment: Patents and IP rights can help to attract investment in AI research and development. This is because they can help to protect the investments of businesses and researchers, and they can give them a competitive advantage.
b) Encourage innovation: Patents and IP rights can encourage innovation by giving businesses and researchers the incentive to develop new AI technologies. This is because they can give them the exclusive right to exploit their inventions for some time.
c) Promote economic growth: Patents and IP rights can promote economic growth by stimulating innovation and investment in AI. This can lead to the creation of new jobs, the development of new industries, and improved access to goods and services.

Generally, patents and IP rights are an important part of the AI-enabling environment in Africa. They can help to attract investment, encourage innovation, and promote economic growth.

Here are some additional details about patents and IP rights:

a) A patent is a legal right that gives the owner the exclusive right to make, use, sell, or import an invention for some time.
b) IP rights also include copyrights, trademarks, and trade secrets.
c) Patents and IP rights can be registered with national patent offices.
d) Patents and IP rights can be enforced through the courts.

Patents and IP rights are not without challenges. For example, they can be expensive to register and enforce. Additionally, they can be difficult to obtain for some types of inventions, such as software. Despite the challenges, patents and IP rights are important tools for the development of AI in Africa. By providing businesses and researchers with the right to protect their inventions, they can help to stimulate innovation and promote economic growth.

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6.5.9 CREATING AND PROTECTING INTELLECTUAL PROPERTY

Intellectual property (IP) is a critical component of the enabling environment for AI technology in Africa. IP rights, such as patents, copyrights, and trademarks, can help to protect AI inventions and innovations and encourage investment and development in the field. There are several examples of how IP is being used to support AI development in Africa. For example, the African Development Bank (AfDB) has launched an AI patent challenge to encourage the development of new AI technologies. The challenge will award prizes to the best AI patents that are submitted. On the other hand, the AfDB is also working with African governments to develop national AI policies that include provisions for IP protection. These policies will help to create a more favourable environment for the development and commercialisation of AI in Africa.

IP protection can have several positive impacts on the development of AI in Africa. It can help to:

a) Attract investment: IP protection can help to attract investment in AI research and development. This is because it can help to protect the investments of businesses and researchers, and it can give them a competitive advantage.

b) Encourage innovation: IP protection can encourage innovation by giving businesses and researchers the incentive to develop new AI technologies. This is because it can give them the exclusive right to exploit their inventions for some time.
c) Promote economic growth: IP protection can promote economic growth by stimulating innovation and investment in AI. This can lead to the creation of new jobs, the development of new industries, and improved access to goods and services.

IP protection plays a crucial role in Africa's AI landscape as it contributes to creating an enabling environment for AI technology. Robust IP protection frameworks help to attract investments from both local and international sources, as investors feel more secure in supporting AI ventures when their intellectual property rights are safeguarded. By offering legal protection for AI innovations, IP protection incentivises and rewards innovation, encouraging researchers, entrepreneurs, and businesses to invest in AI research and development. This, in turn, fosters a culture of innovation, promotes knowledge sharing, and drives economic growth by enabling the commercialisation of AI technologies. Therefore, prioritizing robust IP protection in Africa's AI ecosystem is essential for harnessing the full potential of AI, fostering technological advancements, and promoting sustainable economic development across the continent.

Here are some additional details about IP protection:

a) Patents: Patents are a type of IP right that gives the owner the exclusive right to make, use, sell, or import an invention for some time.
b) Copyrights: Copyrights are a type of IP right that protects original works of authorship, such as books, music, and software.
c) Trademarks: Trademarks are a type of IP right that protects words, phrases, symbols, and designs that are used to identify and distinguish the goods or services of one party from those of others.

While IP protection comes with its challenges, such as high costs and difficulties in obtaining protection for certain inventions like software, it remains an important tool for fostering the development of AI in Africa. Despite the complexities, IP protection provides businesses and researchers with the means to safeguard their inventions and creations, encouraging them to invest in innovative AI solutions. By granting exclusive rights, IP protection incentivises the development of new technologies, promotes knowledge sharing, and drives economic growth. It enables businesses to attract investments, secure competitive advantages, and commercialize their AI innovations. Furthermore, IP protection plays a vital role in establishing a favourable ecosystem that nurtures innovation, fosters collaboration, and facilitates the transfer of technology. Therefore, despite the challenges, prioritizing IP protection in Africa can have significant positive impacts on the advancement and sustainable growth of the AI sector.

Here are some examples of how IP protection has been used to support AI development in Africa:

a) The AfDB's AI patent challenge: The AfDB's AI patent challenge is a competition that encourages the development of new AI technologies. The challenge will award prizes to the best AI patents that are submitted.
b) The African Regional Intellectual Property Organisation (ARIPO): ARIPO is an organisation that works to protect IP rights in Africa. ARIPO has several programmes that support the development and commercialisation of AI in Africa.
c) The South African Patent Office: The South African Patent Office is a government agency that grants patents in South Africa. The South African Patent Office has several programmes that support the development of AI in South Africa.

These are just a few examples of how IP protection is being used to support AI development in Africa. IP protection is an important tool for the development of AI in Africa. It can help to attract investment, encourage innovation, and promote economic growth.

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6.5.10 DATA POLICIES AND REGULATIONS

Creating an enabling environment in Africa for AI necessitates the establishment of robust data policies and regulations. By implementing comprehensive data protection frameworks, Africa can ensure the privacy and security of individuals' data, which is essential for fostering trust in AI technologies. Clear regulations regarding data collection, storage, and usage can provide guidelines for businesses, researchers, and AI practitioners, promoting responsible and ethical AI practices. Additionally, promoting open and accessible data-sharing policies can stimulate collaboration and innovation in the AI ecosystem, allowing for the development of more accurate and diverse AI models. Moreover, data policies that prioritise inclusivity and address issues of bias can help mitigate societal disparities and ensure that AI benefits all segments of the population. By establishing strong data policies and regulations, Africa can create an environment where AI can thrive, unleashing its potential for transformative socioeconomic development while safeguarding individual rights and promoting ethical practices.

Africa can create an enabling environment by having robust data policies and regulations for AI:

a) Create a national data policy: A national data policy can help to ensure that data is collected, stored, and used responsibly and ethically. It can also help to protect the privacy of individuals and businesses.
b) Develop data governance frameworks: Data governance frameworks can help to ensure that data is managed effectively and efficiently. They can also help to ensure that data is used in a way that is consistent with the national data policy.
c) Enforce data protection laws: Data protection laws can help to protect the privacy of individuals and businesses. They can also help to ensure that data is not used in a way that is harmful or discriminatory.
d) Invest in data infrastructure: Data infrastructure is essential for the development and use of AI. Investing in data infrastructure can help to ensure that Africa can collect, store, and use data in a way that supports the development of AI.
e) Promote data literacy: Data literacy is essential for the responsible use of AI. Promoting data literacy can help to ensure that individuals and businesses are aware of the risks and benefits of AI and can make informed decisions about how to use AI.

By taking these steps, Africa can create an enabling environment for the development and use of AI. This can help to boost economic growth, improve social welfare, and address some of the continent's most pressing challenges.

Here are some specific examples of how robust data policies and regulations can benefit Africa:

a) Economic growth: AI can be used to improve productivity, efficiency, and innovation in a wide range of industries. By ensuring that data is collected, stored, and used responsibly and ethically, Africa can create an environment where AI can be used to boost economic growth.
b) Social welfare: AI can be used to improve healthcare, education, and other social services. By ensuring that data is protected and used in a way that respects human rights, Africa can create an environment where AI can be used to improve social welfare.
c) Challenges: Africa faces several challenges, such as poverty, inequality, and climate change. AI can be used to address these challenges. For example, AI can be used to develop new agricultural technologies, improve financial inclusion, and monitor climate change.

By taking steps to create a robust data policy and regulation framework, Africa can position itself to benefit from the immense opportunities that AI offers. Therefore, Africa needs to establish comprehensive data protection laws that prioritise individual privacy, consent, and security. These regulations should address issues such as data collection, storage, sharing, and use, ensuring transparency and accountability. Secondly, fostering collaboration between governments, industry

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stakeholders, and civil society is crucial in developing a consensus on data governance principles and standards. This collaborative approach will help in crafting inclusive and context-specific regulations that consider Africa's diverse cultural, social, and economic landscape. Additionally, investing in the development of data infrastructure, including data centres and secure networks, will facilitate the effective management and utilisation of data for AI applications. By creating a robust data policy and regulation framework, Africa can foster trust, encourage data-driven innovation, attract investments, and unlock the transformative potential of AI, thereby driving economic growth and addressing societal challenges responsibly and inclusively.

6.5.11 UNDERSTANDING NEW REGULATORY DYNAMICS AND BUILDING CAPACITY

To understand new regulatory dynamics and build capacity for AI technology, implementation, and socioeconomic development and growth in Africa, it is crucial to prioritise key areas. Firstly, investing in research and knowledge dissemination about emerging AI regulations and best practices is essential. This involves engaging with international organisations, collaborating with global partners, and conducting comprehensive studies to stay updated on evolving regulatory frameworks. Secondly, fostering partnerships between government, industry, academia, and civil society is vital for capacity building. This collaboration can facilitate knowledge exchange, training programmes, and the development of tailored solutions that align with Africa's unique socioeconomic context. Additionally, promoting AI education and skills development initiatives will empower individuals with the competencies needed to navigate the regulatory landscape and leverage AI's potential effectively. By adopting a proactive and comprehensive approach, Africa can enhance its understanding of regulatory dynamics, build robust AI capacity, and pave the way for sustainable socioeconomic development and growth driven by AI technologies.

Here is how Africa can understand new regulatory dynamics and build capacity for AI technology, implementation, and socioeconomic development and growth:

a) Understand the risks and benefits of AI: Africa needs to understand the risks and benefits of AI to develop and implement policies that are in the best interests of the continent. Some of the risks of AI include bias, discrimination, job displacement, and privacy violations. Some of the benefits of AI include increased productivity, efficiency, and innovation.
b) Develop policies and regulations that are flexible and adaptable: Africa needs to develop policies and regulations that are flexible and adaptable to keep pace with the rapid development of AI. These policies and regulations should be designed to protect the rights of individuals and businesses and to promote the responsible use of AI.
c) Invest in training and education: Africa needs to invest in training and education to build the capacity to develop and use AI. This includes training for policymakers, regulators, businesses, and individuals.
d) Create a culture of innovation and collaboration: Africa needs to create a culture of innovation and collaboration to benefit from the opportunities that AI offers. This includes encouraging businesses to invest in AI research and development, and to collaborate with other businesses and organisations.
e) Promote the use of AI for social good: Africa needs to promote the use of AI for social good. This includes using AI to address challenges such as poverty, inequality, and climate change.

By taking these steps, Africa can position itself to benefit from the opportunities that AI offers.

Here are some specific examples of how Africa can build capacity for AI technology, implementation, and socioeconomic development and growth:

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a) Establish AI research centres: Africa can establish AI research centres to promote research and development in AI. These centres can train researchers, develop new AI technologies, and collaborate with other research centres around the world.
b) Create AI-focused start-up companies: Africa can create AI-focused start-up companies to develop and commercialize new AI-based products and services. These start-up companies can create jobs, generate economic growth, and address some of the continent's most pressing challenges.
c) Partner with international organisations: Africa can partner with international organisations, such as the World Economic Forum and the United Nations, to develop and implement AI policies and regulations. These partnerships can help Africa to learn from the experiences of other countries and to develop policies and regulations that are in the best interests of the continent.
d) Promote the use of AI in education: Africa can promote the use of AI in education to improve the quality of education and to prepare students for the jobs of the future. AI can be used to personalize learning, provide feedback, and deliver instruction more engagingly.
e) Use AI to address social challenges: Africa can use AI to address social challenges such as poverty, inequality, and climate change. For example, AI can be used to develop new agricultural technologies, improve financial inclusion, and monitor climate change.

By taking proactive measures such as implementing robust data policies, promoting AI education and skills development, and fostering collaborative partnerships, Africa can build the necessary capacity for AI technology, implementation, and socioeconomic development and growth. Building capacity involves equipping individuals, businesses, and governments with the knowledge, skills, and resources needed to leverage AI effectively. This includes investing in AI research and development, establishing AI-focused educational programmes, and supporting innovation hubs and incubators. By building a strong foundation of AI capabilities, Africa can harness the transformative power of AI to address societal challenges, drive economic growth, and enhance various sectors such as healthcare, agriculture, finance, and education. Furthermore, by leveraging AI responsibly and inclusively, Africa can bridge the digital divide, promote sustainable development, and unlock new opportunities for socioeconomic advancement, ultimately fostering a prosperous and equitable future for the continent.

6.6 SUPPORTIVE AI ECOSYSTEM

6.6.1 THE AI ECOSYSTEM IN AFRICA

An AI ecosystem comprises key companies, people and initiatives contributing to and building the AI operational environment. The African AI ecosystem comprises groups of stakeholders, and their interdependent relationships, who impact and are impacted by AI.[224] The relationships and power dynamics between these groups govern (i) the distribution of resources, (ii) the development of AI technology, (iii) attitudes toward AI, (iv) the creation of legal and regulatory frameworks, and (v) the advocacy for communities impacted by the adoption of AI. Understanding these interdependent relationships helps in ensuring that the AI ecosystem developed on the continent is equitable and beneficial to all. Figure 8 shows an example of an AI Ecosystem while Table 3 showed the types of stakeholders of the AI ecosystem and examples.

[224] Wairegi, Omino and Gutenburg (2021). AI in Africa: Framing AI through an African Lens: https://journals.openedition.org/ctd/4775?lang=en

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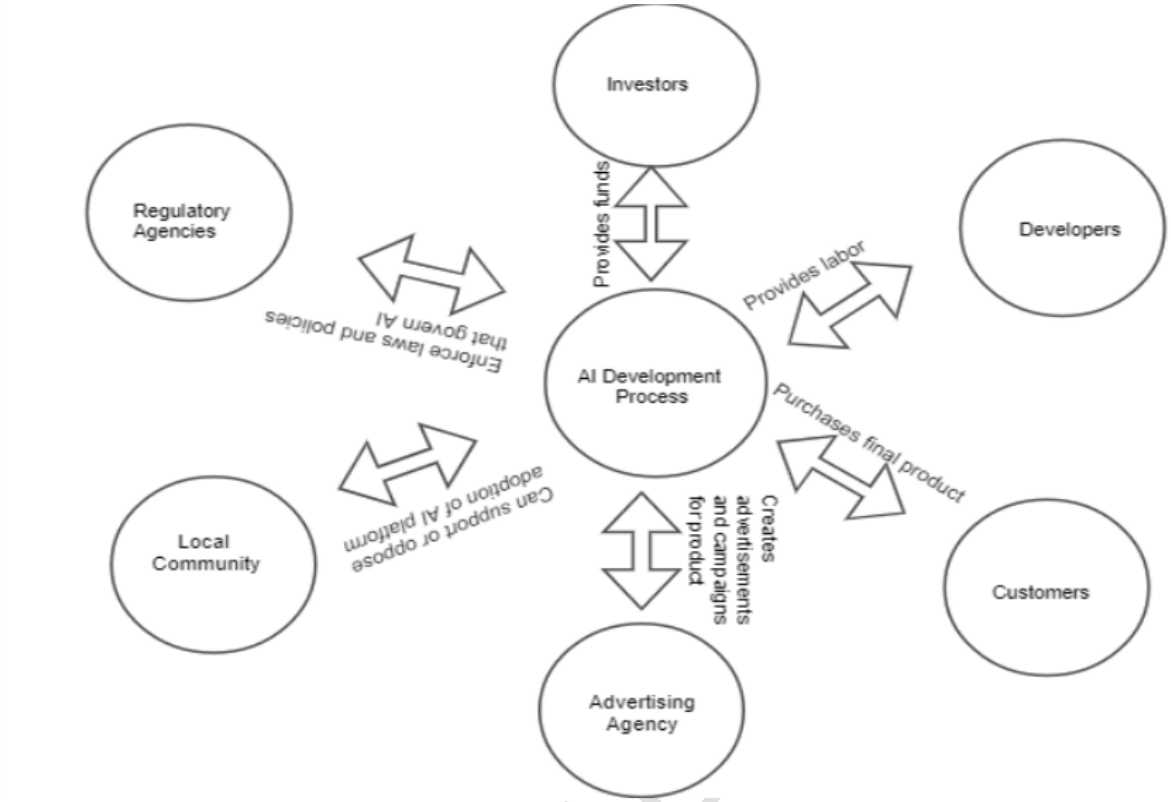

Figure 8. An example of an AI Ecosystem adopted from Wairegi, Omino and Gutenburg (2021)[225]

Table 3. Definitions and examples of types of stakeholders in an AI Ecosystem from Wairegi, Omino and Gutenburg (2021)[226]

Stakeholder type	**Definition**	**Examples**
Primary	Stakeholders with direct input in the AI development and adoption process and who are impacted directly by AI activities.	Investors, developers (e.g., code writers, data analysts, etc.), company owners, customers, and vendors.
Secondary	Parties who have an indirect influence in the AI development and adoption process and indirectly experience the effects of the AI products, positive or negative.	Regulatory agencies, advertising companies, trade unions, consumer groups, and social influencers.
Tertiary	Groups with no direct involvement (or less involvement than secondary stakeholders) in any part of the AI process and who are affected indirectly, more so than secondary stakeholders, by the AI products.	Business competitors, local communities, and continental Unions such as the African Union (AU).

[225] Wairegi, T., Omino, F., & Gutenburg, M. (2021). A novel approach to natural language generation using a transformer-based model. arXiv preprint arXiv:2106.01349.
[226] Wairegi, T., Omino, F., & Gutenburg, M. (2021). A novel approach to natural language generation using a transformer-based model. arXiv preprint arXiv:2106.01349.

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As per the summary in Table 3, key players in the African AI ecosystem include start-up companies using AI, Multinational Tech Companies with branches in Africa, Regulators, Telecommunication companies on the continent, Development community/AI Experts, User community, Incubators and Accelerators, and Vendors of AI products.

6.6.2 START-UP COMPANIES USING AI

These are start-up companies using AI-related technologies in their software solutions, or potentially disruptive technologies using AI. A key pillar of Africa's development is creating more jobs for youth in various economic sectors, especially through entrepreneurship as youth represent 60% of Africa's population. It is therefore important for governments and the private sector to pay attention to AI start-up companies which can be a strong contributor to AI-driven economic growth. Start-ups need the right advice and infrastructure (legal, ethical, technical, etc.) to create responsible AI products. Most African Governments have been promoting and supporting technology companies for years. As a result, many start-up companies have grown exponentially, many of them producing work/services that were earlier on sourced to companies abroad. A few of these companies have grown to become large companies with over 1,000 employees.

However, the development and deployment of AI in Africa are still limited. Africa's biggest companies, the would-be national champions are not zealously championing the cause of AI or deploying AI applications widely. Hence, they are much behind their global counterparts. The few companies that have invested in AI incur high costs due to the importation of talent and technology. In addition, these companies are using AI only in limited ways. The large capital investments required for many AI projects and the slow, uncertain ROI associated with them deter many investors. Also, a large part of the ecosystem's investments is concentrated in very few start-up companies. For example, in 2019, Africa's AI ecosystem raised US$11.27 million, up by 223% from US$3.6 million in 2018 but Tunisia's InstaDeep raised US$7 million representing 62% of the total investment made[6]. Similarly, in 2020, South Africa's DataProphet's US$6 million accounted for half of the US$11.63 million raised in the whole of Africa.[227]

More African companies need to actively drive the development of AI for African nations to leapfrog global rivals. Canada, Israel, and Singapore have become globally competitive in AI by creating linkages between government, business, and academia.[228]

6.6.3 MULTINATIONAL COMPANIES WITH R&D CENTRES IN AFRICA

An increasing number of multinational companies operate Tech R&D centres in Africa that are either specifically focused on AI or have AI as a component. Examples include the Microsoft African Development Centre in Nairobi, Google Africa Office in Ghana, and Amazon Data Centre in Cape Town, South Africa. These are playing critical roles in creating AI solutions for the African context and skilling young Africans in AI and related technologies, among others. However, these Big Tech foreign monopolies currently dominate the continent making it difficult for small local players to enter the market. Further, the economic might of such companies, the investment they bring, and their evasion of domestic laws can negatively impact a government's capacity to protect the rights of citizens and

[227] https://techcabal.com/2022/02/16/inside-nvidia-plans-to-develop-africas-ai-ecosystem/
[228] Canada 2018, Pan-Canadian AI Strategy, http://www.jaist.ac.jp/~bao/AI/OtherAIstrategies/Pan-Canadian%20Artificial%20Intelligence%20Strategy.pdf

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other residents. For example, it is common for social media companies to use AI to filter user content and detect and take down what they consider inflammatory posts based on their algorithms[2]

Additionally, AI technologies developed elsewhere with far fewer benefits for local communities are increasing rapidly. China is the leading exporter of AI-driven technologies to the African continent. China's macro-economic foreign policy, the Belt and Road Initiative, and Beijing's Digital Silk Road Initiative, have been at the forefront of China's AI expansion into Africa[2]. Forty (40) out of 54 African countries had, by May 2021 signed Belt and Road Initiative agreements that have brought smart city infrastructure, 5G networks, surveillance cameras, cloud computing and e-commerce technologies to many African cities[2].

6.6.4 TELECOMMUNICATION COMPANIES ON THE CONTINENT

The telecommunication companies on the continent have large data repositories. However, collection and utilisation of this data are still hampered by low network coverage, poor/limited connectivity, low data literacy among executives and technical staff, weak/non-existent Open Data (OD) policies, etc. Sub-Saharan Africa is the only region where fixed broadband subscriptions are below 1 per 1000 inhabitants[229]. Additionally, more than 20% of the African population is not covered by a 3G or higher network, twice as much as in other regions of the world[230]. This impedes the benefits of participatory sensing, a process of massive sensor data collection via data-sensing devices that would address or reduce algorithmic colonisation. This data is particularly useful in Big Data analytics and evidence-based decision-making due to its volume, granularity, and coverage. AI relies on data, and when the appropriate social, cultural, and political contexts are not provided, it can entrench existing inequalities, prejudices, and injustices. For example, facial recognition software is less accurate when identifying women and people of colour compared to white men[231]. Addressing the structural and infrastructural preconditions of AI like increasing Telecom Network coverage will increase the availability of the vast amounts of data needed to adequately develop and train AI systems. This is essential to building local AI ecosystems that embed local value systems and respond to local problems.

6.6.5 INCUBATORS, ACCELERATORS, AND INNOVATION HUBS

Incubators and Accelerators are Programmes that support start-up companies and the scaling of the next generation of Africa's AI start-up companies. They are designed to promote local innovations in the field of AI, machine learning, and data usage. Usually, they provide start-up companies with technical product development and business development support through a blended accelerator program with a virtual and physical interface. They are customised to boost collaboration between start-up companies and corporates, commercial partners, and investors. An example is the Africa AI Accelerator Program by Ghana Tech Lab in partnership with GIZ's AI and technology entrepreneurship initiatives of FAIR Forward, Make-IT in Africa, and IBM.[232]

On the other hand, Innovation Hubs provide cheap, shared working spaces and free mentorship for young innovators to start and grow their AI-driven enterprises. They are "the backbone of Africa's tech ecosystem as facilitators of growth and synergies across the entrepreneurial ecosystem. But, like start-

[229] Oxford Insights. (2022). Government AI Readiness Index, https://www.oxfordinsights.com/ai-readiness20222, last accessed 2022/08/15.
[230] Szoszkiewicz, L. & Mickiewicz, A. (2021). Open Data: Toward Achieving and Measuring the Sustainable Development Goals. DOI: 10.1007/978-3-319-71059-4_129-1.
[231] Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification: http://proceedings.mlr.press/v81/buolamwini18a/buolamwini18a.pdf
[232] https://africaaiaccelerator.com

up companies, they need support, and a conducive environment to thrive. Some of their key constraints are lack of adequate funding and stringent regulations, which could be addressed by more visible and tangible support from governments such as more youth and stakeholder-led regulation or policy[233]. Examples include Machine Intelligence Africa Institute,[234] Norrsken Kigali House,[235] Innovation Village, Uganda[236] and Innovation Hub on Artificial Intelligence for Sexual, Reproductive, and Maternal Health in Africa Project.[237]

6.6.6 RESEARCH CENTRES AND CENTRES OF EXCELLENCE

AI research activities in Natural Language Processing, machine translation, speech technologies, image understanding, computer vision, and social media analysis among others, are being conducted at several universities and Research Institutions across the continent. For instance, the AI Lab at Makerere University in Uganda has carried out considerable research in Natural Language Processing and crop disease diagnosis[238] while the Centre for Data Science and Artificial Intelligence at Dedan Kimathi University.[239] Kenya is focused on Health, Agriculture and Environment. However, these laboratories are still challenged by limited local expertise, funding, and weak/non-existent legislation among others.

On the other hand, AI Centres of Excellence (AI CoE) are dedicated business units tasked with identifying AI use cases and implementing a region/nationwide AI vision. They bring together AI talent, knowledge, and resources required to enable AI-based transformation projects that start small to build consensus through results, and scale resources gradually. Their major goal is transformation, evolution and change in the AI industry by creating an impact while demystifying AI in Africa and building capacity for AI in Africa as well as creating ethical AI solutions that address Africa's challenges. The AI CoE concept is still new but catching on fast in Africa with several AI CoE springing up in different countries. Examples include the AI Centre of Excellence, Kenya[240] and the African Centre of Excellence on the Internet of Things, Rwanda[241]. The AI CoE model needs more nurturing in Africa for it to grow and mature so that best practices can be shared and replicated in different parts.

6.6.7 GOVERNMENT AND DEVELOPMENT PARTNERS

Most countries have put in place a comprehensive database for citizen data which is a rich data set for the universal digital ID. Further, there is a growing interest in AI from investors and governments which is partly attributed to the conditions that COVID-19 created3. The sudden need for digital collaborative spaces and remote working tools forced business leaders to understand the need for digitization, and this demand included further investments in some aspects of AI and automation. However, Africa is still challenged by a dearth of investment in AI, limited specialised talent, brain drain of top AI talent to the West, lack of access to the latest global research, unavailability of some data due to weak/non-existent open data policies, poor infrastructure, etc. Only 40% of Africans have access to the Internet, compared to 87% in Europe and 95% in North America[242]. AI can exacerbate Africa's digital divide if the challenge of reliable infrastructure, affordable data plans, and access to technology, are not addressed.

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[233]https://www.forbes.com/sites/tobyshapshak/2019/10/30/africa-now-has-643-tech-hubs-which-play-pivotal-role-for-business/?sh=48a200984e15
[234] https://miiafrica.org/about/
[235] https://www.norrsken.org/eastafrica
[236] https://innovationvillage.co.ug/who-we-are/
[237]https://www.idrc.ca/en/project/innovation-hub-artificial-intelligence-sexual-reproductive-and-maternal-health-africa
[238] https://air.ug
[239] https://dekut-dsail.github.io/projects.html
[240] https://vc4a.com/ventures/ai-centre-of-excellence/
[241] https://aceiot.ur.ac.rw
[242] https://oecd-development-matters.org/2021/02/09/developing-an-artificial-intelligence-for-africa-strategy/

Table 4. A summary of the Strengths, Weaknesses, Opportunities and Threats (SWOT) for the AI Ecosystem in Africa.

STRENGTHS	**WEAKNESSES**
a) Some AI research is being carried out in AI Research Laboratories/Centres in Africa. b) National data repositories like the citizen database. c) Common practice of Innovation Hubs/Incubators/Accelerators. d) A predominantly young population. e) Potential of AI to solve many problems in Africa. f) Governments' historical support of technology start-up companies.	a) Limited zeal of Africa's big AI companies to champion the cause of AI & deploy AI applications. b) High cost of investment and uncertain low ROI. c) Limited specialised talent. d) Use of AI in limited ways. e) Concentration of a large part of the ecosystem's investments in very few start-up companies/countries. f) Unavailability of some data. g) Poor infrastructure. h) Weak/non-existent personal Data and Data Governance policies. i) High cost of operation due to importation of talent and technology.
OPPORTUNITIES	**THREATS**
a) Growing interest in AI from Investors and Government. b) Big global technology companies running R&D Centres in Africa.	a) Brain drains. b) Lack of access to the latest global research. c) Dominance of big Tech foreign monopolies. d) Rapid increase of AI technologies developed elsewhere with far fewer benefits for local communities.

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As a strength, the SWOT analysis for the AI ecosystem in Africa is demonstrating that the continent has some form of AI research being carried out in AI Research Laboratories and Centres in Africa. There are several AI research laboratories and centres in Africa, such as the African Institute for Mathematical Sciences (AIMS), the Alan Turing Institute, and the ICIPE Research Institute. These laboratories and centres are conducting research on a variety of AI topics, including natural language processing, machine learning, and computer vision. Further to this, there are some national data repositories such as the citizen database. Many African countries have national data repositories, such as the citizen database in Kenya. These databases contain a wealth of data that can be used to train AI models.

In terms of the common practice of innovation hubs, incubators, and accelerators, there is a growing practice of innovation hubs, incubators, and accelerators in Africa. These organisations provide support

to early-stage AI startups, such as access to mentors, funding, and workspace. There is also a predominantly young population in Africa. Additionally, Africa has a predominantly young population, with over 60% of the population under the age of 25. This young population is a potential source of talent for the AI industry. This presents the potential of AI to solve many problems in Africa. AI has the potential to solve many problems in Africa, such as poverty, disease, and climate change. For example, AI can be used to improve agricultural yields, develop new medical treatments, and monitor climate change. Fortunately, many African governments have a history of supporting technology start-up companies. This support can help to create a favourable environment for the growth of the AI industry. However, this needs to be expanded and strengthened.

On the weaknesses side, there is the limited zeal of Africa's big AI companies to champion the cause of AI and deploy AI applications. Some of the big AI companies in Africa have not been very enthusiastic about promoting the use of AI or deploying AI applications. This lack of zeal could hinder the growth of the AI industry in Africa. Furthermore, there is a high cost of investment and uncertain low ROI. The cost of investing in AI can be high, and the return on investment (ROI) is often uncertain. This can discourage investors from investing in AI projects. Additionally, there is a limited pool of specialized talent in Africa with the skills needed to develop and deploy AI applications. This lack of talent could hinder the growth of the AI industry in Africa.

AI is currently being used in Africa in a limited number of ways. For example, AI is being used to improve agricultural yields and develop new medical treatments. However, AI has the potential to be used in many other ways, such as to improve education, create jobs, and reduce poverty. As a result, the concentration of a large part of the ecosystem's investments is in very few start-up companies and countries. A large part of the investments in the AI ecosystem in Africa is concentrated in a few start-up companies and countries. This concentration could make the ecosystem vulnerable to shocks, such as the failure of a few key companies. Moreover, there is also a common unavailability of some essential data that can strengthen AI models and logarithms in Africa. This is because the data that is needed to train AI models is virtually not available in Africa, and this could subsequently hinder the development of AI applications in Africa.

The infrastructure in Africa is often poor, which can make it difficult to deploy AI applications. For example, the internet connection in Africa is often slow and unreliable. There are also weak and non-existent personal data and data governance policies in many African countries. This lack of policies could hinder the development and use of AI in Africa. There is also a high cost of operation due to the importation of talent and technology. The cost of operating an AI company in Africa can be high, due to the need to import talent and technology from abroad. Consequently, this high cost could make it difficult for AI companies to compete with foreign companies.

There are some opportunities for AI development and implementation in Africa to bolster socioeconomic development and growth for the continent. For instance, there is a growing interest in AI from investors and government to accelerate the growth of the industry. As such, big global technology companies such as Google and Microsoft are running R&D Centres in Africa. Consequently, these R&D centres could help to transfer knowledge and technology to African AI companies, which could help to accelerate the growth of the industry.

The risk of brain drain in the AI industry poses a significant challenge for Africa. Talented AI professionals may choose to seek opportunities with foreign companies, which can have detrimental effects on the growth and development of the AI industry within the continent. As these skilled individuals leave Africa, valuable expertise, knowledge, and innovative potential are lost, resulting in a shortage of talent and a diminished pool of experts who can contribute to the local AI ecosystem. This brain drain not only affects the availability of skilled professionals but also hampers the establishment of a self-sustaining AI industry that can drive economic growth, technological advancements, and social progress in Africa. Efforts to retain and attract AI talent, foster a supportive ecosystem, and provide enticing opportunities within Africa are crucial to mitigate the brain drain risk and nurture a thriving AI sector on the continent.

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6.7 POLICY RECOMMENDATIONS

Given the current situation of the African AI Ecosystem and the need to make it robust and conducive for all key actors, several policy recommendations are provided, summarised as follows:

6.7.1 SUPPORT AI START-UP COMPANIES IN AFRICA TO GROW AND SCALE UP

A key pillar of Africa's development is creating more job opportunities for youth in various economic sectors, especially through entrepreneurship. African governments and the private sector should pay equal attention to local AI start-up companies which can be a strong contributor an AI-driven economic growth. This requires helping start-up companies with the right advice and infrastructure (legal, ethical, technical, etc.) needed to create responsible AI products, grow, and scale up quickly.

The following actions can boost start-up companies using AI in Africa:

a) Increase the funding offered to start-up companies through government-related bodies and other available funding streams;

b) Create AI-specific startup incubators. These will provide office space, business and market advice, clerical help, etc to reduce the cost of starting a company and channel the focus of the engineers and scientists toward the technical problem at hand.

c) Provide incentives for public and private companies to purchase AI products locally (from African AI companies) rather than import from abroad;

d) Initiate continental and national projects that make use of AI technologies. This will solve continental and national problems and boost the AI industry in Africa. Some of the projects can be presented in the form of a competition as an incentive for producing the best work.

e) Provide technology parks, innovation hubs, R&D grants, etc to avail needed infrastructure and help. Organise competitions at different levels to stimulate the use of AI in solving real challenges and creating new market opportunities. The purpose of these competitions should be to bring promising entrepreneurs and start-up companies from around the world in contact with investors, mentors, donors, and government representatives to solve innovation challenges using AI applications. Further, this will offer an opportunity to match start-up companies with larger companies on the national and multinational levels. These challenges and competitions will also raise awareness of AI technologies in Africa and individual countries, as well as provide a platform for participants to share AI ideas and applications and support the development of their entrepreneurial skills.

f) Engage academia to train and provide low-cost talent and research on local needs/problems. This will create an AI ecosystem with lower development costs, AI applications tailored to local needs, and a reduction in dependence on foreign companies.

> ***"African companies can help create an AI ecosystem that will lower their development costs, help create AI applications tailored to local needs, and reduce dependence on foreign companies."***

6.7.2 REGIONAL COOPERATION

Regional cooperation is an important policy option for developing common regulatory responses for multinational and foreign tech companies operating in the region. This cooperation should also extend to developing taxation regimes for multinational platforms. Further, regional cooperation is needed to develop data-sharing agreements between countries that provide access to a broader range of public sector data, useful in advancing developmental priorities, for local AI developers. The African

Continental Free Trade Area Protocol on E-Commerce is an important opportunity for integrating a provision to support inter-regional data sharing and thus support regional development goals and economic growth.[243]

6.7.3 INTERNATIONAL DEVELOPMENT ASSISTANCE

International development assistance remains an important opportunity for African development. In supporting the adoption of responsible AI solutions on the continent, donors, intergovernmental organisations, and other funders should be sought to support efforts to build inclusive digital infrastructure and develop long-term local capacity in AI governance, as is being seen with the Africa-EU Global Gateway investment scheme. However, an emphasis should be placed on ensuring African states retain their sovereignty in developing AI governance solutions that are built on national constitutional and related-founding principles and advance the realisation of local development priorities.

The announcement of the Africa-EU Global Gateway to provide €150 billion of investments in Africa, including in relation to both the green and digital transitions, is a critical step in supporting cooperation between the two regions.

6.7.4 ATTRACTIVE PARTNERS FOR GLOBAL DIGITAL GIANTS

The African AI ecosystem should position itself as an attractive partner for global digital giants keen to enter the African market. This can be achieved through various ways: ensuring access to data, infrastructure, and licences, growing AI talent and nurturing R&D in AI and related technologies, etc. In February 2020, Safaricom, a subsidiary of the Kenyan state-owned utility, Telekom Kenya, and Amazon Web Services (AWS) entered a partnership to sell AWS cloud services to its East African customers making Safaricom, AWS' first consulting partner in East Africa.[244]

6.7.5 CREATE AN ENVIRONMENT IN WHICH AI CAN TAKE ROOT

Africa's business leaders should work with national governments to drive the creation of effective AI policy frameworks. Ecosystem growth, especially those that need to scale across national borders, requires flexible regulatory systems.[245] For Instance, in 2021 the Kenya government formed an AI and blockchain task force made up of local blockchain start-up companies, AI experts, academics, researchers, local ICT experts, various regulatory bodies, lawyers and representatives from several corporations including IBM[246]. This task force has since published an insightful report on how to exploit opportunities in blockchain and AI for added efficiency in the public sector in Kenya. The report also notes the need for the government to invest in blockchain and AI infrastructure and promote start-up companies in AI and related technologies[247].

Further, Government projects can provide a boost to AI companies in Africa. It would be beneficial for African countries if most Government projects are allocated to local companies or international

[244] https://oecd-development-matters.org/2021/02/09/developing-an-artificial-intelligence-for-africa-strategy/
[245] AI in Africa: Key Concerns and Policy Considerations for the Future of the Continent: https://afripoli.org/ai-in-africa-key-concerns-and-policy-considerations-for-the-future-of-the-continent
[246] https://www.globenewswire.com/news-release/2022/02/21/2388709/0/en/Morocco-s-Mohammed-VI-Polytechnic-University-and-ALPHA10X-Sign-Research-and-Development-Partnership-Agreement.html
[247] https://oecd-development-matters.org/2021/02/09/developing-an-artificial-intelligence-for-africa-strategy/

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companies with an office in the country, provided that the quality and/or cost expected is as favourable or better as any other purely international company.

The 2021 Egypt AI strategy provides a 4-stage process for enabling competent local AI start-up companies to take up implementation of government projects:

a) Run a pilot, announced as a competition, using a subset of relevant, non-sensitive, legally approved data. Companies are free to apply their algorithms on this data subset as a preliminary test, like kaggle.com's competitions.
b) Solicit a written proposal from candidate companies that will present their solution for potential funding.
c) Review the proposals, and based on the solution methodology, quality and reputation of the participants, and performance in the blind competition, decide on the best company to award.
d) For large projects or certain specific projects, stipulate that any foreign company that bids for a project should have a local joint partner company.

6.7.6 ESTABLISH AI CENTRES OF EXCELLENCE (AI COE)

Each country should set up a Centre of Excellence (CoE) for supporting the application of AI to governmental and non-governmental problems. The AI CoE should employ highly qualified AI researchers with higher degrees and practical experience, for it to be a vehicle for designing AI solutions and implementing them for a variety of problems facing the country and continent.

Specifically, the AI CoE should play the following roles:

a) Tackling national projects earmarked in National Development Plans that can benefit from the use of AI and big data. For example, health, agriculture, education, and the environment, among others.

b) Contacting government ministries and government agencies to search for tasks where AI can be applied for more efficient operation and better performance. Many government agencies may not have the AI insight to know that some of their operations can be improved using AI.

c) The CoE can be a vehicle to reverse the brain drain by specifically targeting the employment of local researchers with higher degrees (such as PhD) from top universities of the world.

d) The CoE can provide internships for students and recent graduates as Research Trainees thereby giving them real experience in tackling AI problems which can create a talented AI workforce that will also benefit other sectors.

6.7.7 INFRASTRUCTURE DEVELOPMENT ACCESS TO DATA AND LICENCES

Every effort should be made by African governments to focus policy efforts on building and maintaining safe, secure, and inclusive infrastructure to support the local development of AI. This focus includes policies to advance internet access and to prevent local actors from enacting internet shutdowns, as well as policies to support the good governance and availability of data for development.

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The African Union Commission in February 2022 underscores equitable access to digital and data-driven technologies for all Africans. As such, the Continental Data Policy Framework (CDPF) is a policy document that was adopted by the African Union Commission (AUC) in February 2022. The CDPF aims to promote the responsible use of data in Africa, with a focus on equitable access to digital and data-driven technologies for all Africans. The CDPF sets out several principles for the governance of data in Africa, including the right to privacy, the right to data protection, and the right to access and use data. The CDPF also establishes several institutions and mechanisms for the implementation of the policy, including the African Data Governance Forum (ADGF) and the African Data Protection Authority (APDA).

The CDPF is a significant step forward for Africa in the development of a comprehensive data policy framework. The CDPF has the potential to promote the responsible use of data in Africa and to ensure that all Africans have equitable access to digital and data-driven technologies.

Here are some of the key points of the CDPF:

a) Data should be used for the benefit of all Africans, and not for the benefit of a few.
b) Africans should have the right to privacy and the right to control their data.
c) Africans should have access to affordable and reliable data infrastructure.
d) Africans should be able to develop and use data-driven technologies to improve their lives.

The CDPF is a living document that will be updated as needed. The AUC is committed to working with African governments, businesses, and civil society to implement the CDPF and to ensure that all Africans benefit from the opportunities that data offers. On the other hand, the Africa-EU Global Gateway project which is set to provide €150 billion of investments in Africa with investments in submarine and terrestrial fibre-optic cables, and cloud and data infrastructures among others,[248] is hoped to significantly boost network and data infrastructure in Africa.

6.7.8 GROW AI TALENT

Africa has abundant raw talent being home to the fastest-growing population on the planet and the youngest, with 60% of its population under 25 years of age. Governments and local/continental AI companies should form partnerships with global educational institutions to develop AI talent. For example, Morocco's Mohammed VI Polytechnique University and OCP Group partnered with Ecole des Mines, Ecole Polytechnique, MIT, Columbia University, and École Polytechnique Fédérale de Lausanne (EPFL) to open several AI graduate and executive programmes as well as a new generation of coding schools in Benguerir and Khouribga[249]. Also, more Innovative forms of trans-continental collaboration such as Deep Learning Indaba,[250] which is fostering a community of AI researchers in Africa, should be promoted. Further, tools such as Zindi[251], a platform that challenges African data scientists to solve the continent's toughest challenges, are needed across Africa. As the AI infrastructure expands and the use of applications rises, African companies will expand and grow rapidly which will make them a breeding ground for talent forcing multinational companies to collaborate with them.[252]

The development of AI and related data and technology skills among policymakers and workforces on the continent is a key precondition for developing and supporting the responsible use and development of AI. Holistic capacity development policies are needed to promote understanding of AI at all levels,

[248] https://ecdpm.org/work/global-gateway-and-eu-digital-actor-africa
[249] https://www.globenewswire.com/news-release/2022/02/21/2388709/0/en/Morocco-s-Mohammed-VI-Polytechnic-University-and-ALPHA10X-Sign-Research-and-Development-Partnership-Agreement.html
[250] https://deeplearningindaba.com/2022/
[251] https://zindi.africa
[252] UAE 2018, UAE National Strategy for AI 2031, https://ai.gov.ae/wp-content/uploads/2021/07/UAE-National-Strategy-for-Artificial-Intelligence-2031.pdf

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with specific policy measures to advance women in STEM and AI-related decision-making positions. Policy provisions in this area may also include measures to attract diverse AI talent by lifting entry barriers into countries for Africans with data science and computing skills and attracting African Scientists and Engineers trained abroad to return home.[253]

The impact of automation on job loss for African women who occupy most positions of low-skilled labour and repetitive tasks hence first targets of automation should be given adequate attention in re-skilling programmes. Similarly, policy measures for reskilling programmes should consider the daily realities of African women who bear the burden of domestic responsibilities and have no or limited time to reskill for the digital world.

6.7.9 COMBAT BRAIN DRAIN OF AI TALENT

The immigration of African scientists and engineers to more advanced economies can have the most detrimental impact on the health of the AI sector in Africa. The success of the AI industry mainly depends on the availability of talent. The following steps are suggested to reverse the trend:

a) Centres of Excellence in AI (AI CoE) should favour the employment of faculty members with PhD from leading international universities to attract them to come back.

b) AI CoE could hire African/National expatriates that are prominent worldwide. For example, a leading African/National AI Researcher living in the US could be hired as a consultant on a part-time basis at an AI CoEs. With remote employment becoming prevalent, this arrangement is feasible.

6.7.10 COMMUNITY PARTICIPATION AND BENEFICIATION

With the enormous economic promise of AI and the society-wide implications of some AI applications such as biometric ID systems, every effort should be made to involve local communities in decisions around the design and deployment of AI systems that may affect them. In addition, beneficiation frameworks should be developed to support dividends for communities whose data are used in developing AI systems. Hence, beneficiation should be a key principle of national AI ethical guidelines.

6.7.11 ADVANCING AFRICAN VALUE SYSTEMS AND PRINCIPLES IN AI ETHICS

Within the diverse social and cultural contexts found within the African region, ethical standards for AI should emphasise digital literacy and education, community beneficiation, holistic reskilling programmes, access to basic digital infrastructure, protection of minority ethnic communities and promotion of diverse forms of knowledge in developing AI solutions.

6.7.12 REGULATE AI-DRIVEN LABOR SECTOR

The growing AI-driven gig economies such as Uber, Jumia, and Bolt Food, operational across many African countries, pose risks to workers who are offered limited job security such as insurance,

[253] Scotland 2021, Scotland's AI Strategy, https://static1.squarespace.com/static/5dc00e9e32cd095744be7634/t/606430e006dc4a462a5fa1d4/1617178862157/Scotlands_AI_Strategy_Web_updated_single_page_aps.pdf

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healthcare and leave with pay and are routinely subjected to intrusive surveillance, nudging and control of behaviour through algorithmic systems. Kenya has a fast-growing gig economy with 93,000 gig workers projected to be active in the country by 2023[254]. The labour rights of this new group of workers need to be included in national labour laws and guidelines.

6.8 ENHANCED KNOWLEDGE OF AI AT ALL LEVELS: LEAVING NOBODY BEHIND AND STRONG TECHNICAL KNOW HOW

Any country that wants to benefit from AI should build the capacity of its citizens. Particularly, human capacity development should be targeted at general awareness (AI for All), formal education, AI-related research, and the skilling and reskilling of the current workforce.[255] General and public awareness will create a base of knowledgeable and educated citizens who understand the benefits of AI. This should include a systematic delivery of lifelong AI education. As such, Africa's formal education system requires changes to accommodate the demands of the Fourth Industrial Revolution. This will require the revision of our school curriculum from primary school to university levels including technical and vocational education. Furthermore, extra attention should be paid to STEM education, and coding and computer programming should be introduced early in school to provide the foundational skills needed by the AI ecosystem. Due to the ubiquitous nature of the application of AI, there is a need for full-scale AI convergence education. These efforts should be accompanied by strengthening the capacity of teachers and improving the infrastructure for teaching and learning in schools.

African countries will also require expertise in AI-related research and development. This is possible if countries strengthen national research structures and develop expertise through research cooperation with leading AI nations. The focus should be on acquiring skills for interdisciplinary research and its sustainable utilisation to solve the numerous challenges facing the continent. Therefore, to bolster the AI expertise of African countries, we need to establish a system for nurturing top AI talent and professionals. Also, the almost non-existent AI expertise means the current technology workforce requires skilling and reskilling. Finally, due to the concept of AI + X where X represents any field of endeavour, different occupational groups including public sector officials and policymakers should receive relevant training in AI. However, all these efforts at developing AI expertise will yield positive results only when we provide attractive working conditions to retain AI professionals on the continent.

AI inevitably brings with it, a wave of change which affects and permeates all aspects of our daily lives. With all this change on the horizon, governments and heads of state should take into consideration the potential risks inherent in being "left behind" and the ultimate disintegration of society about skilled of skilled labour, education, and agriculture. AI requires an increase in human knowledge and understanding of the use of technology and its benefits. It is common cause that AI is changing the nature of work as new jobs will be created, whilst others will disappear entirely. In most cases, jobs will be transformed with the integration of AI. It is on this basis that Governments and heads of state alike should adopt and prioritise the inclusion of modern technology in the education sector spanning across all levels.

In an African context, this entails a modernisation of education, upskilling educators and empowering the learner to explore and develop innovative AI technology for the betterment of society. The implementation of policies and strategies whilst looking forward to the future should not disregard the present. The current workforce should be also empowered and educated on the use of AI technology which can primarily be achieved through progressive partnerships with the private sector. Therefore, governments remain the primary driving force and should be seen to endorse the use of AI within its

[254] ai in africa: key concerns and policy considerations for the future of the continent: https://afripoli.org/ai-in-africa-key-concerns-and-policy-considerations-for-the-future-of-the-continent.

[255] Turkey 2021, National AI Strategy 2021 – 2025, https://wp.oecd.ai/app/uploads/2021/12/Turkey_National_Artificial_Intelligence_Strategy_2021-2025.pdf

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spheres thereby leading the charge in the introduction and implementation of AI technology. The steps to achieve the successful introduction and implementation of AI Technology, include the following:

a) Encourage the modernisation of education and adopt policies and regulations to enable the modernisation;
b) Anticipate the possible changes in the labour market and subsequently take proactive steps to mitigate against any potential decline in societal welfare;
c) Adapt Africa's social protection systems to protect the labour market; and
d) Facilitate the introduction of AI technology into the private sector including small businesses which may in some instances require the incentivisation of the use of AI technology.

Modernisation of education should be a priority for African governments. Fundamentally, all Africans should have every opportunity to acquire the skills they need. Additionally, talent should be nurtured, and gender balance and diversity encouraged. African countries should also prepare for socioeconomic changes that are brought about by AI. This can be accomplished by encouraging the modernisation of education and training systems, nurturing talent, anticipating changes in the labour market, supporting labour market transitions, and enabling the adaptation of social protection systems. Markedly, throughout history, the emergence of new technologies such as electricity and the internet has substantively changed the nature of work. Consequently, this has brought substantive societal and economic benefits but also raised concerns. Therefore, the emergence of automation, robotics and AI is transforming the labour market, and it remains critical for African countries to effectively manage these changes.

6.8.1 DEMYSTIFYING AI TO INFLUENCE THE MINDSET CHANGE AND AWARENESS

To successfully deploy AI-enabled technologies across the African continent, African countries should be intentional in introducing and implementing a mindset change. This entails *inter alia* extracting value from AI-related innovation and also patronising local innovation of Africans across the African continent. Furthermore, local, and national ownership of AI remains fundamental and requires leadership and participation, at all levels and in every socioeconomic sector of society. Therefore, African countries should unify toward achieving a common goal, where individuals have a stake in and a shared responsibility for delivering the common development agenda. Thus, in implementing a mindset change, there should be an understanding of the principal mindset theories and how they impact the development and deployment of AI technology.

Table 5. Influencing the mindset changes in Africa

FIXED MINDSET	**GROWTH MINDSET**
a) Focuses on talents and efforts alone b) Low AI adoption and implementation c) Much greater need for advocacy and diplomacy	a) Focuses on expanding intelligence b) Increase in AI adoption and implementation c) Wide acceptance thus not much need for advocacy

6.8.2 RESEARCH & DEVELOPMENT AND CENTRES OF EXCELLENCE AROUND SOCIOECONOMIC CHALLENGES

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Although Africa accounts for nearly 17% of the world's population, it generates less than 1% of the world's research.[256] Creating an enabling environment for Artificial Intelligence (AI) in African countries using research and development (R&D) can help these nations unlock the transformative power of AI for economic growth, social development, and improved governance. African countries can establish research institutions and centres of excellence focused on AI R&D.[257] These institutions can collaborate with universities, the private sector, and international partners to develop AI-based solutions that are tailored to African needs.[258] In Ghana, the Swedish International Development Agency (SIDA), IDRC and GIZ have collaborated to support the establishment of the Responsible AI Lab (RAIL) at the Kwame Nkrumah University of Science and Technology to research and provide AI solutions to African challenges. This is a regional lab with satellite lab satellite laboratories at The Alioune Diop University of Bambey in Senegal, the University of Cape Verde, and The Gambia Technical Training Institute (GTTI). The Centre will also be used to nurture AI talent and train postgraduate students. African countries can collaborate locally and with international partners to share knowledge and resources in AI development. Collaboration can help African countries avoid duplicating efforts and accelerate progress in AI innovation.

6.8.3 INTRODUCE AI IN THE EDUCATIONAL SYSTEM

Policy interventions can play a crucial role in introducing AI into the African educational system. Here are some policy interventions that African countries can implement to create an enabling environment for AI in education. For instance, National AI strategies of African countries should prioritise the integration of AI into the education system. These strategies can outline the objectives, goals, and targets for introducing AI in education and identify the necessary resources and stakeholders to achieve these goals. AI should be integrated into the education system at all levels from primary up to tertiary. AI education should also address issues such as data privacy, bias, and fairness in AI systems. African governments should allocate funds for the development and implementation of AI in education. These funds can be used for training teachers in AI, developing Acurricula, providing access to AI tools and resources, and funding research and development in AI.[259]

African countries can form partnerships with the private sector and international development organisations to support the introduction of AI in education. The private sector and international organisations can provide resources, expertise, and funding to support the development and implementation of AI in education. These collaborations are necessary to provide AI training programmes that incorporate on-the-job training and practical modules. An example is the Ghana AI Fellowship Programme which was initiated by GIZ. This fellowship programme combines face-to-face teaching with practical training in technology organisations.[260]

African countries can collaborate with international organisations and other countries to share best practices and resources for introducing AI in education. This can help African countries learn from the experiences of other countries and accelerate progress in AI integration in education. For example, the African Union has developed a Framework on Artificial Intelligence that guides how to use AI in education. The framework includes recommendations on how to develop AI-enabled learning materials,

[256] https://www.elsevier.com/connect/africa-generatesless-than-1-of-the-worlds-research-data-analytics-canchange-that. Accessed 15 Jun 2020.
[257] Bangladesh 2019, National Strategy for AI Bangladesh, https://ictd.portal.gov.bd/sites/default/files/files/ictd.portal.gov.bd/page/6c9773a2_7556_4395_bbec_f132b9d819f0/Draft%20-%20Mastering%20National%20Strategy%20for%20Artificial%20Intellgence%20-%20Bangladesh.pdf
[258] Lithuanian 2020, Lithuanian AI Strategy, http://kurklt.lt/wp-content/uploads/2018/09/StrategyIndesignpdf.pdf
[259] Malta 2019, A strategy and vision for AI in Malta 2030, https://malta.ai/wp-content/uploads/2019/11/Malta_The_Ultimate_AI_Launchpad_vFinal.pdf
[260] Singapore 2019, National AI Strategy, https://www.smartnation.gov.sg/files/publications/national-ai-strategy.pdf

how to train teachers on how to use AI in the classroom, and how to assess the impact of AI on education.[261]

In addition, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) has launched a program called AI for Education that aims to support countries in using AI to improve education. The program provides resources, training, and technical assistance to help countries develop and implement AI-based educational programmes. Therefore, by collaborating with international organisations and other countries, African countries can gain access to the latest research and best practices on AI in education. This can help them to accelerate the development and implementation of AI-based educational programmes that will benefit their students.

African countries can attend conferences and workshops on AI in education that are organized by international organisations, such as UNESCO and the African Union. These events provide opportunities for African educators and policymakers to learn about the latest research and best practices on AI in education. Moreover, African countries can partner with universities and research institutions in other countries that have expertise in AI in education. These partnerships can provide African countries with access to expertise, resources, and training on AI in education.[262]

African countries can join international networks of educators and policymakers who are working on AI in education. These networks provide a forum for African educators and policymakers to share experiences, collaborate on projects, and advocate for the use of AI in education. Therefore, by collaborating with international organisations and other countries, African countries can gain access to the latest research and best practices on AI in education. This can help them to accelerate the development and implementation of AI-based educational programmes that will benefit their students.

6.8.4 FUTURE OF WORK AND CONTINUOUS PROFESSIONAL DEVELOPMENT

To create an enabling AI environment in African countries, policies around the future of work and continuous professional development are essential. Here are some policy interventions that African countries can implement:

1. Skills Development: African countries can develop policies that promote skills development in areas related to AI. This can include policies that encourage lifelong learning, upskilling and reskilling programmes, and partnerships between industry and academia to ensure that the skills developed align with the needs of the job market.[263]

Case Study: In Kenya, the government has developed the Ajira Digital Program, which aims to provide digital skills training to over one million young people. The program includes AI-related skills such as data analytics and machine learning, and it also provides opportunities for freelancing and entrepreneurship.

[261] 1. Mexico 2018, AI Strategy in Mexico, https://7da2ca8d-b80d-4593-a0ab-5272e2b9c6c5.filesusr.com/ugd/7be025_e726c582191c49d2b8b6517a590151f6.pdf.
[262] Switzerland, Recommendations of an AI Strategy in Switzerland, https://www.satw.ch/fileadmin/user_upload/documents/02_Themen/08_Kuenstliche-Intelligenz/SATW-Swiss_AI_Strategy.pdf.
[263] Denmark 2019, The Danish Government National Strategy for AI (2019), https://eng.em.dk/media/13081/305755-gb-version_4k.pdf.

2. Social Protection: African countries can develop policies that address the potential impact of AI on the workforce. These policies can include social protection mechanisms such as unemployment insurance, income support, and retraining programmes to help workers transition to new jobs or sectors.[264]

Case Study: In Rwanda, the government has implemented a social protection program that provides income support and skills training to vulnerable households. The program includes training in AI-related skills such as data analysis and programming, which can help individuals transition to jobs in the digital economy.

3. Entrepreneurship and Innovation: African countries can develop policies that promote entrepreneurship and innovation in AI-related fields. This can include policies that support the establishment of incubators, accelerators, and venture capital funds to provide support for AI start-up companies.

Case Study: In Ghana, the government has established the Ghana Tech Lab, which supports start-up companies in the technology sector, including AI-related ventures. The lab provides resources such as funding, mentorship, and networking opportunities to support the growth of these start-up companies.

6.8.5 CAREER TRANSITIONING AND SWITCHING

Beyond the uplift in labour demand resulting from economic factors, AI will in and of itself require new jobs and new roles. Along with jobs in the development and application of AI, the technologies will need to be built, maintained, operated, and regulated. Particularly, many of the key jobs that AI will create, will look nothing like those that exist today.[265] As such, AI-generation jobs fall into three categories:

a) **Trainers**: People that will teach AI technologies how to perform and where possible mimic human behaviours including how to show compassion, detect sarcasm and use humour in appropriate situations;

b) **Explainers**: Technical professionals who can explain how algorithms and AI technologies work and understand why the response and output are a certain conclusion or action. These jobs will act to 'bridge the gap between technologies and business leaders. Specifically, jobs in this category could include Context Designers and AI Strategists;

c) **Sustainers**: Individuals who ensure that AI systems are operating effectively and appropriately, such as economists and ethicists.

Hence, there is a need to support a broader range of people to enter AI-related jobs by ensuring career pathways. This can be accomplished by highlighting opportunities to work with or develop AI. There is a need to enhance and expand interest in AI education and research by supporting the opening of new AI faculties, opening or re-branding existing ones, and increasing the number of new graduates in the market each year.[266]

[264] 1ortugal 2019, Portuguese National initiative on digital skills AI, https://www.incode2030.gov.pt/sites/default/files/julho_incode_brochura.pdf.
[265] Australia 2020, The future of AI (AI) in Australia, https://melbourne.org.au/wp-content/uploads/2020/12/CFM_Artificial_Intelligence_Report_03_HR-1.pdf
[266] Estonia 2019, Estonia's National AI Strategy, https://f98cc689-5814-47ec-86b3-db505a7c3978.filesusr.com/ugd/7df26f_27a618cb80a648c38be427194affa2f3.pdf

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6.8.6 STRONG TECHNICAL KNOW-HOW

Strengthening the digital component of education entails a good foundation for scientific education at the tertiary level and requires enhancing digital literacy as early as kindergarten. Thus, there is a need to strengthen the digital component of education by introducing programming skills, statistical, analytical, and critical thinking skills as well as the basics of data protection and intellectual protection laws. These skills can adequately provide technological competency and creativity.[267] Such skills are necessary for the development of capabilities for Big Data analytics. Relevant public authorities need to ensure that digital skills are embedded in education at all stages, including lifelong education for adults.[268] Remarkedly, building a wide range of ICT competencies, including programming, critical thinking, and basic statistical skills, remains essential in the context of the robotification of the economy.[269] This is because such efforts are preparing individuals for higher-end work in analysis, verification, and the optimisation of algorithm-based processes.[270]

6.9 AI RISK, SAFETY, AND LONG-TERM DEVELOPMENT

African governments can formulate policies to regulate the development and use of AI. These policies should address concerns such as bias, privacy, and job displacement to ensure responsible AI practices. Furthermore, companies operating in Africa can establish ethical frameworks for AI development and use. These guidelines will promote responsible and beneficial AI applications, safeguarding against misuse and negative consequences. Additionally, African researchers can focus on developing technologies that mitigate AI risks. By creating tools to detect and address bias in AI algorithms, they can prevent discrimination and the harmful use of AI technology.[271]

In addition, establishing a digital community for African AI stakeholders would be instrumental. This community would serve as a platform for discussion, collaboration, and the formulation of policies and guidelines for safe and responsible AI use. Therefore, addressing AI risk, safety, and long-term development in Africa will have significant impacts. This can be accomplished by creating clear regulations and responsible practices as this will attract greater investment in AI research and development and foster technological advancements in Africa. African businesses and consumers will benefit from improved access to AI-powered products and services, resulting in increased efficiency and effectiveness in various sectors. Most importantly, the adoption of AI technologies can lead to economic growth and job creation across Africa, promoting innovation, entrepreneurship, and market competitiveness. Further to this, by leveraging AI advancements, healthcare, education, and other social services in Africa can be improved, leading to better outcomes and increased accessibility for communities.

In particular, addressing AI risk, safety, and long-term development in Africa will drive positive socioeconomic outcomes, positioning the continent as a hub for responsible and impactful AI utilisation. As such, African governments can formulate policies to regulate the development and use of AI. These policies should address concerns such as bias, privacy, and job displacement to ensure responsible AI practices. Furthermore, companies operating in Africa can establish ethical frameworks for AI development and use. These guidelines will promote responsible and beneficial AI applications, safeguarding against misuse and negative consequences. More so, African researchers can focus on

[267] Chaudron S, Di Gioia R, Gemo M (2017). Children (0–8) and digital technology – a qualitative study across Europe. Publications Office of the European Union. Luxembourg.
[268] Norway 2020, National Strategy for AI, https://www.regjeringen.no/contentassets/1febbbb2c4fd4b7d92c67ddd353b6ae8/en-gb/pdfs/ki-strategi_en.pdf
[269] Russia 2020, AI in Russia, https://www.cna.org/archive/CNA_Files/centres/cna/sppp/rsp/newsletter/dop-2020-u-027701-final2.pdf.
[270] Szoszkiewicz, L. & Mickiewicz, A. (2021). Open Data: Toward Achieving and Measuring the Sustainable Development Goals. DOI: 10.1007/978-3-319-71059-4_129-1.
[271] Republic of Serbia 2020, Strategy for the Development of AI in the Republic of Serbia, https://www.media.srbija.gov.rs/medsrp/dokumenti/strategy_artificial_intelligence.pdf.

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developing technologies that mitigate AI risks. By creating tools to detect and address bias in AI algorithms, they can prevent discrimination and the harmful use of AI technology.

6.10 CONTINENTAL FRAMEWORKS ON TECHNOLOGY REGULATION AND ENABLING ENVIRONMENTS

The potential impacts of implementing continental frameworks on technology regulation and enabling environments in Africa will include increased investment in technology research and development. Businesses and governments would be more likely to invest in technology if they were confident that it was being developed and used safely and responsibly. Furthermore, there can be improved access to technology-powered products and services. African businesses and consumers would have greater access to technology-powered products and services if the risks and challenges of technology were addressed.[272]

The continental framework can also enhance economic growth and job creation. The use of technology could lead to increased economic growth and job creation in Africa. Most importantly, consumers and users can be protected from the risks of technology. Additionally, the framework could also help to protect consumers and users from the risks of technology, such as data privacy violations, cybercrime, and the spread of misinformation.

For example, the continental frameworks on technology regulation could create an enabling environment in Africa to help African governments to develop policies to regulate the development and use of technology. These policies could also address issues such as data privacy, cybercrime, and the spread of misinformation. As such, African companies could develop ethical guidelines for the development and use of technology. These guidelines could help to ensure that technology is used responsibly and beneficially. Further to this, African researchers could develop new technologies to mitigate the risks of technology. These technologies could help to prevent technology from being used for harmful purposes.

The establishment of a continental framework for technology regulation and enabling environments could help to address these issues. The framework could provide a common set of rules and regulations for the development and use of technology in Africa. This could help to create a more level playing field for businesses and organisations and to protect consumers and users. This can be accomplished by creating an environment where the AU could develop a continental policy on data privacy. The policy could include rules on how data can be collected, used, and shared.

The AU could develop a continental strategy for the development of artificial intelligence. The strategy could outline the continent's goals for the development and use of AI and could include policies to address issues such as bias, privacy, and job displacement. Additionally, the AU could also establish a continental centre for research on the ethical and legal implications of technology. The centre could provide research and advice to governments, businesses, and organisations on the responsible use of technology.

The establishment of a continental framework for technology regulation and enabling environments would be a valuable resource for addressing the risks, safety, and long-term development of technology in Africa. The framework could help to increase investment in technology research and development, improve access to technology-powered products and services, and lead to increased economic growth and job creation. The framework could also help to protect consumers and users from the risks of technology.

[272] Czech Republic 2019, National AI Strategy of the Czech Republic, https://www.mpo.cz/assets/en/guidepost/for-the-media/press-releases/2019/5/NAIS_eng_web.pdf.

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6.11 ADHERING TO CONTINENTAL FRAMEWORKS AND POLICIES

Adhering to continental frameworks and policies on AI in Africa holds significant potential for addressing the risks, safety, and long-term development of AI in the region. By establishing and implementing these frameworks, African countries can create a unified and harmonized approach towards AI adoption. This coherence will instil confidence among investors and stakeholders, leading to increased investment in AI research and development. With greater investment, African countries can foster innovation, drive technological advancements, and nurture local AI talent.[273]

Moreover, adherence to continental frameworks and policies will contribute to improving access to AI-powered products and services across Africa. By establishing clear guidelines for responsible and ethical AI practices, consumers and businesses will have greater trust in AI technologies. This trust will facilitate the adoption and integration of AI solutions in various sectors, enhancing efficiency, productivity, and competitiveness.[274] Furthermore, improved access to AI-powered services can have a transformative impact on healthcare, education, and other social services. AI technologies can enable more accurate diagnoses, personalized learning experiences, and targeted interventions, ultimately improving the quality and accessibility of these essential services for African populations.[275]

Generally, the adherence to continental frameworks and policies on AI in Africa will create an enabling environment for sustainable AI development. This will not only attract investment and drive economic growth but also pave the way for improved social services and a higher standard of living for the people of Africa.

African governments could adopt the African Union's Framework on Artificial Intelligence and set up national AI bodies to oversee its implementation. These bodies could be responsible for developing and implementing national AI policies, and for regulating the development and use of AI in their countries. As such, African companies could develop their own AI policies that align with the continental frameworks and policies. These policies could help to ensure that they are using AI responsibly and beneficially and that they are complying with the law. Furthermore, African researchers could develop new technologies that help to mitigate the risks of AI. These technologies could help to prevent AI from being used for harmful purposes.

The adherence to continental frameworks and policies on AI could have several positive impacts. It would help to increase investment in AI research and development. Businesses and governments would be more likely to invest in AI if they were confident that it was being developed and used safely and responsibly. This could also improve access to AI-powered products and services. African businesses and consumers would have greater access to AI-powered products and services if the risks and challenges of AI were addressed. Furthermore, there can be increased economic growth and job creation. The use of AI could lead to increased economic growth and job creation in Africa. This includes improved healthcare, education, and other social services. AI could be used to improve healthcare, education, and other social services in Africa.

For example, the South African government could adopt the African Union's Framework on Artificial Intelligence and set up a national AI body to oversee its implementation. The body could be responsible for developing and implementing national AI policies, and for regulating the development and use of AI in South Africa. Furthermore, the Kenyan company Ushahidi could develop its own AI policy that aligns with the continental frameworks and policies. The policy could help to ensure that Ushahidi is using AI responsibly and beneficially and that it is complying with the law. Additionally, the Nigerian research team at the University of Lagos could develop a new technology that helps to mitigate the risks

[273] EU AI Act 2021 https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF
[274] China 2017, A Next Generation AI Development Plan, https://d1y8sb8igg2f8e.cloudfront.net/documents/translation-fulltext-8.1.17.pdf.
[275] Republic of Korea 2019, The Government of the Republic of Korea National Strategy for AI, https://www.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=10&mPid=9&pageIndex=&bbsSeqNo=46&nttSeqNo=9&searchOpt=ALL&searchTxt=.

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of AI bias. The technology could be used to prevent AI from being used to discriminate against people based on race, gender, or other factors.

6.12 RECOMMENDATIONS

Here are recommendations for building an enabling environment for AI in Africa, summarised as follows:

6.12.1 BUILDING AND INCLUSIVE DIGITAL INFRASTRUCTURE

a) Build inclusive digital infrastructure that provides affordable and accessible broadband and capabilities for deploying AI systems for both private and public services. Building digital infrastructure is essential for creating an enabling environment for AI. This includes improving access to high-speed internet, increasing the availability of cloud services, and investing in computing resources. In collaboration with the private sector, African governments should ensure that the foundational infrastructure for AI is provided.
b) To deploy AI-powered digital government services, African countries should put in place digital public infrastructure that provides capabilities for digital identification, consent, privacy, and security, interoperability of systems, and data exchange.
c) Furthermore, African governments should ensure that the prices of digital devices and equipment are affordable by considering removing taxes on equipment and exploring funding schemes with the private sector to make equipment affordable and available to citizens.

6.12.2 PROVIDING ACCESS TO AI TECHNOLOGY

a) Provide access to AI technology including making a conscious effort to democratise AI in African countries. As such, African governments should facilitate the introduction of AI technology into the private sector including small businesses which may in some instances require the incentivisation of the use of AI technology.
b) To reduce the barriers to AI adoption and use, African governments should focus on democratising AI by making AI technology available to all through the production of AI-related digital public goods.
c) In collaboration with all stakeholders, African governments should explore policies and actions on Open Data, Open Storage and Computing, Open AI models, Open AI Algorithms, and Open AI marketplaces.

6.12.3 ACCESS TO QUALITY DATA

a) African countries should develop comprehensive national data strategies that include data collection, storage, sharing, and analysis to ensure the availability and quality of data for AI development.
b) African government should create a data marketplace. The national data strategies should also tackle challenges related to the availability, accessibility, and commercialisation of data. Furthermore, the national data strategies should provide guidelines on data standards, data classification, and data governance. Data governance frameworks and data standards will ensure data quality and interoperability across different systems.

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c) African governments should promote the use of open data platforms and Application Programming Interfaces (APIs) to facilitate access to data by AI developers and researchers.[276]

6.12.4 ANTICIPATION OF THE POSSIBLE CHANGES IN THE LABOUR MARKET

a) African countries should anticipate the possible changes in the labour market and subsequently take proactive steps to mitigate any negative effects. As such, governments and businesses in African countries should invest significantly in education and skills development programmes to ensure that workers have the necessary skills to thrive in an AI-powered economy.
b) African countries should also invest in STEM education and vocational training programmes that provide practical, hands-on experience in areas such as data analysis, robotics, and programming.
c) African governments should implement social safety nets to provide a safety net for workers who may be displaced by AI. This can include unemployment benefits that include training programmes for reskilling and job placement services.
d) To effectively prepare for the impact of AI on the labour market, governments, businesses, and civil society should work together collaboratively. This includes sharing knowledge and expertise and developing joint strategies to address the challenges and opportunities presented by AI.

6.12.5 INVESTING IN AI EDUCATION

a) African countries should invest in AI Education by providing education, training, and awareness at all levels of society. Investing in AI education is crucial for developing the skills and expertise needed to build, deploy, and maintain AI systems.
b) African countries should prioritise AI education at all levels of the education system and promote AI research and development. Invest in AI education and training programmes to build a skilled workforce that can develop and use AI technology effectively. The concept of "AI +X" should be introduced at the secondary and tertiary levels, allowing students to understand how AI is affecting every facet of life. This will require reviewing and modernising our educational curriculum for all subjects.
c) With the rapid pace of technological change, workers in African countries should be prepared to learn and adapt throughout their careers. Governments and businesses can promote lifelong learning by providing opportunities for workers to update their skills and knowledge. To not leave anyone behind, there should be an awareness creation programme targeted at the informal sector and citizens without formal education.
d) There should also be a media campaign on changing the mindset of citizens for them to function in a digital economy with AI playing a dominant role. Furthermore, there is a need for innovative ways of funding human capital development with a focus on Research and Development (R&D) that bridges the gap between academia and business. Centres of Excellence working on indigenous Africa AI research should be supported to train postgraduate students and future researchers in AI.
e) African countries should partner with the private sector and international development to build regional centres of excellence with satellite laboratories in other African countries to leverage the limited resources available and to promote collaboration across borders.

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[276] Mauritius 2018, The Mauritius Artificial Strategy, https://ncb.govmu.org/ncb/strategicplans/MauritiusAIStrategy2018.pdf

6.12.6 IMPLEMENTING MECHANISMS TO RETAIN AI TALENT IN AFRICA

a) African countries should offer competitive compensation packages to attract and retain AI talent. This includes competitive salaries, benefits, and bonuses that are on par with those offered in other regions of the world. African governments can facilitate the relocation and repatriation of AI talent.
b) To retain AI talent, African countries should provide opportunities for career growth and advancement. This includes opportunities for professional development, mentorship, and leadership roles within organisations. African countries should foster a culture of innovation and creativity to attract and retain AI talent. This includes providing a supportive environment for advanced research, experimentation, and risk-taking, and encouraging collaboration and knowledge sharing.
c) African countries can engage with the global AI community by participating in conferences, hackathons, and other events that bring together AI researchers and practitioners from around the world. This will help to showcase the potential of AI in Africa and attract talented individuals to the region.

6.12.7 CREATION OF A SUPPORTIVE AI ECOSYSTEM

a) African countries should create a supportive AI ecosystem that fosters collaboration, provides support for start-up companies, and spurs the growth of AI by initiating national and continental AI projects. Collaboration between the public and private sectors, academia, and civil society is crucial for creating an enabling environment for AI. This includes creating partnerships to promote research, development, and deployment of AI, and developing ecosystems that support AI start-up companies and entrepreneurs.
b) Encourage the development of AI start-up companies and SMEs through funding and support programmes, such as incubators and accelerators. Support for start-up companies should include funding through government-related bodies and projects, incubator and accelerator programmes that offer office space, and technical and business advisory services. African government should provide for public and private organisations to purchase local AI solutions.
c) Another way to create a vibrant AI ecosystem is by initiating continental and national AI projects to solve African challenges. Furthermore, national, regional, and continental centres of excellence should be set up to support research and development and provide solutions for the indigenous African challenges.
d) African governments should foster public-private partnerships to facilitate the development and adoption of AI technology in different sectors, such as health, education, and agriculture. African government should also provide incentives for private sector investment in AI development, such as tax breaks and funding for research and development.
e) African countries should foster international collaborations and partnerships to share knowledge and resources and to participate in global AI initiatives and projects.

6.12.8 STRENGTHENING DATA PRIVACY AND SECURITY

a) African countries should develop AI policies, regulations, and Ethical AI Frameworks that promote data privacy, and security and address social and ethical issues. Developing AI policies and regulations is crucial for promoting responsible AI development and deployment.
b) African countries should work towards developing ethical AI frameworks and regulations that promote transparency, accountability, and the protection of privacy and human rights. Also, data privacy and security are essential for creating an enabling environment for AI.

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c) African countries should promote the development of robust data protection laws and regulations that promote the responsible use of personal data. Furthermore, addressing social and ethical concerns is crucial for promoting responsible AI development and deployment.
d) African countries should promote public awareness of AI, engage with civil society organisations, and promote public participation in AI policymaking processes.

Specifically, the following are recommended:

a) Establish an AI council at AU, RECs, and member state level to research and advise the government on handling new AI space developments like the ChatGPT and deep fakes and issue guidance notes to keep the environment came and recommendations to existing guidance. Each nation should have an AI ethics council that encourages sectorial or industrial-led self-regulation.
b) All member countries should adopt or develop their National AI strategy laying out a vision and plan for adopting or developing AI in government, private sector, and academia - identifying enablers and AI initiatives the government can instigate to accelerate safe and responsible AI.
c) AI governance: An important set in the journey of AI governance is the identification of the ethical principles for the Ethical AI Framework and AI governance legislation.
d) National Data Strategy, data protection and privacy (quality data for AI - data sharing and reuse)
e) Patent and intellectual property, Lability and Competition Law (innovation and commerce) Existing copyright and intellectual property protection mechanisms should be strengthened via collaboration via WIPO and PAIPO.
f) Massively invest in ICT and AI infrastructure such as broadband internet, provision of affordable devices, (PC, Mobile phones, etc), encourage the development of local data centres, and national cloud infrastructure.
g) The African Union should make it mandatory that multinational firms (Google, Facebook, apple, etc) set up physical offices and/or R&D laboratories across the subregion of the continent similar to the debate within the EU. This will facilitate official interactions, the development of Africa-compliant products, efficient use of support services, and skills promotion.

6.12.9 ENCOURAGING INVESTMENT IN AI

a) African countries should encourage investment in AI is crucial for promoting AI development and deployment in African countries. This includes creating incentives for AI research and development, providing tax breaks and other financial incentives for AI start-up companies and entrepreneurs, and promoting investment in AI infrastructure.

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7 PILLAR 4: AI ECONOMY

7.1 INTRODUCTION

AI has become a buzzword in recent years due to its transformative potential in various sectors of the economy. Africa, as a continent, has been actively pursuing ways to harness the power of AI to improve the lives of its citizens It is necessary to explore the current state of AI financing in Africa, highlighting the various sources of funding available, the challenges facing AI financing, and potential solutions to overcome these challenges. Specifically, addressing the role of governments, private investors, and development partners in financing AI and building the AI economy in Africa.

To finance and develop the AI economy in Africa, it is essential to have both government support and private investment. Governments can play a critical role in providing financial and regulatory support to AI development, including tax incentives and favourable policies to attract private investment. This support can help to create a conducive environment for AI development, leading to job creation, economic growth, and social transformation.

Equity investments, such as venture capital, are a popular source of funding for AI start-up companies. However, these investments often come with the requirement of a high return on investment, which can be difficult to achieve in the early stages of AI development in Africa. In contrast, non-equity investments, such as grants and loans, can provide vital support to early-stage AI projects. These investments may not require immediate returns on investment but can offer long-term benefits to the African economy.

African governments are encouraged to promote local investments to ensure access to capital for AI startup companies and businesses. Consequently, this can create an economic environment that allows for cross-border investment, public-private partnerships, and ease of trade within the continent. But to accomplish this, a collaborative continental effort can enable Africa to fully realise its potential and bridge the gap within the global north. By exploring these issues and implementing the recommendations, Africa can accelerate AI development and ensure that the benefits of this emerging technology are accessible to all Africans.

7.2 VALUE PROPOSITION FOR AI IN AFRICA

7.2.1 TRENDS OF GLOBAL INVESTMENT IN AI TECHNOLOGIES

The global investment in AI has increased rapidly to approximately US$20 billion and US$30 billion in 2016. Particularly, 90% of this investment was spent on research, development, innovation, and deployment of AI technologies. 10% of this investment was spent on AI acquisitions. However, this kind of investment is predominantly observed within huge digital companies such as Google and Baidu. Furthermore, private investors invested between US$4 billion and US$5 billion in venture capital in 2016.[277] A further US$1 billion to US$3 billion was invested into private equity. Even though most of the current uses of AI are still in the experimental phase, commercial applications are progressively emerging in various socioeconomic sectors. For example, AI systems are filtering suspicious emails, recommending products for purchase, providing legal advice, and driving cars.[278]

Africa has observed successes of mobile technologies which are prompting speculation among technology investors that AI applications may also be successful in African nations. After all, mobile technologies have enabled African nations considerably escalated their communication capacities and

[277] Alaerts, G.J. Financing for Water—Water for Financing: A Global Review of Policy and Practice. Sustainability 2019, 11, 821. https://doi.org/10.3390/su11030821.
[278] file:///C:/Users/bmbuli/Downloads/1BGDEA2022002.pdf.

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advanced their information and technology infrastructure.[279] Therefore, there are expectations that similar benefits and economic opportunities will be observed with AI technologies and tools. Regrettably, only a few African countries such as Kenya, South Africa, Nigeria, Ghana, and Ethiopia are investing towards AI applications. Thus, African countries should develop the essential factors that are necessary for AI technology to expand across the African continent. As it stands, the infrastructural requirements necessary for the African continent to enhance capacities of requisite reforms in data collection and data privacy, infrastructure, education, and governance. Outstandingly, without these infrastructural improvements, most African nations will be incapable to exploit AI technologies to expand sustainable development and inclusive growth.[280]

Some African countries have successfully adopted and rapidly converged AI technologies. Within these African countries, AI initiatives are still mostly small-scale, pilot, or ad hoc. However, these initiatives are demonstrating promising outcomes and have subsequently attracted substantial patronage from global corporations. Unfortunately, there are still some obstacles that are impeding AI's broader adoption across the African region. As such, African countries should explore enabling factors that are underpinning the promise of AI ventures.

For example, the Uneasy Environment for AI has utilised the most basic AI-based algorithmic techniques to model systems to discover patterns, interpret the data to generate insights and enhance decision-making and predictions. Apple's Siri and Amazon's Alexa are AI-based virtual assistants that are utilising algorithms to match single voiceprints against subsequent repetitions of the same phrase. Through this, these applications can learn and predict natural-language requests.

Furthermore, learning thermostats such as Google's Nest valued at approximately US$3.2 billion in 2014, are utilising behavioural algorithms to learn individual heating and cooling needs. Based on this data, the system can then adjust the temperature in the user's home based on their personal preferences. In addition, AI is being applied in the analysis of large genome sets to prevent diseases and facilitate the mapping of human mobility patterns to predict and control humanitarian crises. To accomplish these functions, AI relies on digital foundations to handle large volumes of data—usually referred to as "big data". Consequently, these AI-powered machinery systems can analyse this data to learn, make connections, and make decisions.[281]

7.2.2 THE ADVANCEMENT OF AI SOLUTIONS AND APPLICATIONS IN AFRICA

AI-enabled solutions are being scaled up in some African countries such as Kenya, Nigeria, Ghana, Ethiopia, and South Africa. Worth noting is that most of the AI solutions being implemented are targeting the financial services, agriculture, and healthcare sectors. For example, South Africa is leading the continent in AI adoption and implementation with an ecosystem that encapsulates several technology hubs, research groups, and forums such as the AI Summit. This ecosystem is sponsored by multinational companies such as Intel, Salesforce, Amazon, IBM, and Singularity University's South Africa Summit. Currently, there are approximately 100 or more companies in South Africa that are either incorporating AI solutions into their existing operations or developing new AI solutions.[282]

In some other African countries, companies such as IBM, Microsoft, Google, and Facebook are developing AI solutions as well. For example, the first Google's next AI research laboratory was launched in Accra, Ghana in 2018.[283] Furthermore, IBM is operating AI-oriented research laboratories in Kenya and South Africa. As such in Kenya, IBM's US$100 million initiative called Project Lucy is an extension of the company's supercomputer Watson. This project is focused on addressing challenges

[279] https://www.un.org/africarenewal/magazine/may-july-2017/africa%E2%80%99s-digital-rise-hooked-innovation.
[280] https://www.atlanticcouncil.org/wp-content/uploads/2019/09/Coming-to-Life-Artificial-Intelligence-in-Africa.pdf.
[281] https://www.worldresearchlibrary.org/up_proc/pdf/1870-153923408522-30.pdf.
[282] http://www.scielo.org.za/pdf/ajic/v26/02.pdf
[283] https://edition.cnn.com/2019/04/14/africa/google-ai-center-accra-intl/index.html.

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faced in healthcare, financial inclusion, water and sanitation, human mobility, and agriculture. Facebook launched its first African technology hub in Lagos earlier in 2018.[284]

There are also capacity strengthening and training programmes such as the year-long AI Research Residency Programme with the company's AI Research Group. Additionally, there are some smaller and yet-to-be-well-coordinated efforts to enhance AI capacity in Africa.[285] For example, a privately operated AI research lab in Addis Ababa, Ethiopia, iCog Laboratories was launched in 2013 with US$50,000.[286] iCog Laboratories is currently running programmes of AI research and development services for Ethiopian and international customers and educating young Ethiopians in computer coding, hardware, and entrepreneurship. iCog Laboratories' domestic interests are aligned with the government's development priorities in education and agriculture. Like many emergent AI and technology ventures across the African region, iCog Laboratories is focusing on public and private sector-led development solutions.

A Nigerian chatbot called Kudi AI was integrated into Facebook's Messenger application to facilitate mobile banking and payment services.[287] This is useful to users who have no access or limited access to browser-based online banking but are comfortable with text-based messaging. This application has grown to over 5,000 users since its launch in 2017. Remarkably, Kudi AI received seed funding from the Silicon Valley incubator Y-Combinator. It is also among the progressively growing AI-powered applications in Africa that were designed to broaden financial banking and services to underserved populations. Similarly, the MomConnect chatbot was initiated by the South African National Department of Health to connect approximately 1.8 million expectant mothers to pre-natal and post-natal services. The registered women can essentially chat with the application to receive healthcare advice applicable to their pregnancy.[288]

There is an opportunity to deliver AI-enabled commercial and social services in African markets. For example, in August 2018, IBM launched a Watson Workspace messaging application that was designed to streamline corporate workflow in Nigeria. Further to this, the application was adopted by Nigeria's Descasio cloud services provider to augment its email services and expand employee collaboration. Markedly, the apparent success of these AI technologies and other AI ventures in select African markets is advancing despite numerous data, regulatory, and workforce challenges. This demonstrates the benefits and opportunities of successfully adopting these technologies in African countries that could create and foster enabling AI environments.

7.2.3 STRENGTHENING EXISTING DIGITAL FOUNDATIONS TO SUPPORT AI VENTURES IN AFRICA

Remarkably, the early AI technology adopters in developed economies have significantly advanced their digital transformations. However, in the African markets where AI is taking shape, digital foundations such as the widespread mobile phone penetration and established mobile technology solutions can serve as a baseline of technological infrastructure. This includes ensuring sufficient mobile and internet connectivity and reliability. In addition, consumer awareness and acceptance of AI technology-driven solutions can build trust and discover new and localised opportunities and possibilities for consumer engagement.

For example, Kenya has a mobile phone penetration of approximately 94% and almost a quarter of the country's households have an internet connection. This is among the highest in the developing world. Additionally, in a population of approximately 48 million people, approximately seven (7) million Kenyans have Facebook accounts and another ten (10) million are utilising WhatsApp. Interestingly,

[284] https://openresearch-repository.anu.edu.au/bitstream/1885/196551/1/Titus%20Thesis%202021.pdf.
[285] https://www.idrc.ca/en/project/capacity-strengthening-responsible-artificial-intelligence-ai-research-africa-ai.
[286] https://www.wathi.org/coming-to-life-artificial-intelligence-in-africa-atlantic-council-africa-center-2018/.
[287] https://techcrunch.com/2017/02/13/kudi-payments-through-messaging/.
[288] https://www.health.gov.za/momconnect/.

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the country's mobile money transfer platform known as MPesa has recorded the highest number of mobile money transactions in the world approximately one-third of Kenya's GDP.[289] Therefore, such an environment is potentially demonstrating a favourable environment for AI providers to coalesce their solutions with existing services and products. For instance, an AI-based precision farming application known as the UjuziKilimo application utilises machine learning and data analytics to enable Kenyan farmers to optimise their irrigation schedules and practices.[290] This technology is interfacing with the established SMS technology.

Nigeria has a mobile phone penetration of 84% and technology start-up solutions are attracting an average of US$73,000 in investment.[291] Further to this, the country's venture capital is pursuing the AI market to leverage existing mobile solutions. For example, Nigeria's Ubenwa startup is focusing on detecting birth asphyxia by employing inbuilt smartphone microphones and speech recognition algorithms. These tools can identify the condition based on the amplitude and frequency of the infant's cry.[292]

7.2.4 ADVANCING AI TECHNOLOGIES IN AFRICAN COUNTRIES PROVIDING AN ENABLING ENVIRONMENT

Most importantly, AI companies operating in African markets with strong digital foundations can capitalise on their earlier waves of technological innovation. For instance, these companies can leverage existing technology providers as early adopters such as chatbots for financial technology platforms. The landscape of the African market is youthful and familiar with and open to innovative technology-driven solutions, rendering the market with the potential to significantly expand if appropriately exploited.

However, African governmental support remains crucial because AI ventures can succeed in African markets when key enabling factors are established and developed. Worth noting is that AI is significantly growing in Africa within countries that are prioritising it. Therefore, AI can flourish in African countries where their governments are making AI technology a national priority.[293] This includes undertaking and instituting concerted measures to stimulate a favourable innovation environment by improving data protection, research, and development. For example, African countries such as Kenya, Ghana, South Africa, Ethiopia, and Nigeria are aggressively advancing AI technologies and these technologies are beginning to demonstrate profitability.

For instance, the Kenyan Ministry of Information, Communication, and Technology (ICT) has established an eleven-person Blockchain and AI Taskforce to explore how the 4th Industrial Revolution technologies can best be utilised to strengthen and expand the country's socioeconomic development and growth. Worth noting, with a three-month tenure, the team proposed a 15-year roadmap with that highlighted specific milestones in 2027 and 2037. The investments into blockchain and AI infrastructure and skills were to combat corruption and implement educational and skills programmes for the 4IR.[294]

Similarly, the Nigerian government has established an agency on robotics and AI for the southeast region. This region is generally considered an energy industrial region with the country's most entrepreneurial areas. Over the last eight (8) years, technological hubs and start-up communities have been mushrooming and expanding in areas outside Lagos, including Enugu, Abuja, Ibadan, and Port Harcourt.[295] This is significantly diversifying Nigeria's innovation landscape through the help of the

[289] https://www.connectingafrica.com/author.asp?section_id=761&doc_id=768744.
[290] https://www.ujuzikilimo.com/blog.
[291] https://thenationonlineng.net/how-nigeria-became-leading-player-in-artificial-intelligence-in-africa/.
[292] https://qz.com/africa/1158185/nigerian-ai-health-startup-ubenwa-hopes-to-save-thousands-of-babies-lives-every-year.
[293] https://ircai.org/wp-content/uploads/2021/03/AI4D_Report_Responsible_AI_in_SSA.pdf.
[294] https://www.ict.go.ke/blockchain.pdf.
[295] https://qz.com/africa/2012780/nigeria-ranks-first-in-african-startups-but-faces-challenges.

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new AI agency. These efforts are also attracting financing and encouraging participation in other building blocks that are necessary for AI to develop and scale.[296]

Several African governments are progressively realising that commercial technology solutions can help them fulfil their development goals and address government bureaucratic service deliveries in their agencies. African governments are also realising that for such solutions to prevailing, essential regulatory and infrastructure bottlenecks should be eliminated to improve technological adoption. To this end, decision-makers, and policymakers in African countries such as Ghana and South Africa have endorsed comprehensive data protection legislation. Particularly, two of only eleven Sub-Sahar African countries have presented some form of legislation to enable the adoption of AI technology so far.

Likewise, Ghana's 2012 Data Protection Act is regulating how personal information can be acquired, stored, and disclosed.[297] The Protection of Personal Information Act which was signed into law in South Africa in 2013 similarly introduced an overarching framework for processing personal information.[298] As a result, South Africa is setting up a supervisory function to ensure legislative compliance. Furthermore, Ghana is one of the few African countries with an open data initiative. Therefore, for technological innovations to successfully progress in the long term, enabling policies on innovation is necessary.

In December 2019, Egypt proposed to formulate an African working group tasked with developing the first unified strategy on AI across the continent. The initiative was aimed at providing the African continent with the opportunity to formulate a unified African position in AI technology, and further collaborate with the private sector and international institutions.[299]

7.2.5 STRENGTHENING THE CULTURE OF RESEARCH, DEVELOPMENT, AND INNOVATION TO BOLSTER AI VENTURES IN AFRICA

Google's decision to locate its AI research laboratory in Ghana because of the country's strong ecosystem of local universities and growing network of technology hubs. Ghana has 24 technology hubs. On the other hand, South Africa has 59, Nigeria has 55, and Kenya has 30.[300] Ghana has at least 10 public universities and several private institutions. Most of these institutions are also maintaining partnerships and collaborations with universities across the globe. For instance, the Ghana Technology University College was founded in 2005 by Ghana Telecom, the national telecommunications company. This college has academic collaborations and links with universities and colleges in the United States of America, Kenya, Germany, Denmark, South Korea, and the United Kingdom. This institution is offering various degree programmes, including a Master of Science in Entrepreneurship and Technology.

Universities and technology hubs are essential pathways through which African countries can attain, domesticate, and disseminate emerging technologies within the local economy. Most importantly, universities can also identify emerging technologies that can serve as a platform for generating new products and services to address local challenges. For example, at the AI and Robotics Centre of Excellence situated at Addis Ababa Science and Technology University, researchers are developing AI-driven technological and innovative solutions to address challenges in Ethiopia's agricultural sector.[301] For instance, the institution has created flying insect robots to assist with crop surveillance. Most importantly, despite the country's overall poor education, efforts are being implemented to develop science and technology skills. To this end, Ethiopia has established over thirty (30) official universities and approximately 130 polytechnics. These institutions are emphasising technology and have

[296] https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/coming-to-life-artificial-intelligence-in-africa/.
[297] https://www.dataguidance.com/notes/ghana-data-protection-overview.
[298] https://www.dataguidance.com/notes/south-africa-data-protection-overview.
[299] Egypt 2019, Egypt National AI Strategy, https://mcit.gov.eg/Upcont/Documents/Publications_672021000_Egypt-National-AI-Strategy-English.pdf
[300] https://www.cnbc.com/2018/06/14/google-ai-research-center-to-open-in-ghana-africa.html.
[301] https://edhe.co.za/entrepreneurial-stellenbosch-university-showcases-its-entrepreneurship-and-innovation-successes/.

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collaborations with the country's emergent technology hubs such as Bluemoon, IceAddis, and Sheba Valley.

Similar collaborations between South African universities and technology hubs are demonstrated to be strong drivers of AI innovation. For example, the LaunchLab at Stellenbosch University has successfully incubated student-led start-up companies in areas such as blockchain, financial technology, 3D printing, and AI technology.[302] Other noteworthy South African AI initiatives include the Centre for AI Research (CAIR) which is a joint initiative of the School of Mathematics, Statistics, and Computer Science at the University of KwaZulu-Natal and the Council for Scientific and Industrial Research (CSIR), the Computational Intelligence Research Group at the University of Pretoria, Robotics and Agents Lab at the University of Cape Town, and the Mobile Intelligence.

Connecting universities to technology hubs are potentially promoting AI innovation and other disruptive technologies by incorporating teaching, research, product development, and commercialisation. Currently, in most African countries, these functions remain fragmented and separated, thereby, impeding the opportunities of presenting local AI innovation into the African markets. This approach is essential because it can create a well-designed value chain for specific AI solutions by connecting them with vital stakeholders through continuous interactions.

Currently, the most successful AI ventures in Africa are being sponsored and sustained by global partnerships to facilitate financing mechanisms and technical support. For example, iCog Laboratories is supported by SingularityNET, and these are two (2) American AI firms and Humanity. The latter is an international organisation that is focused on the ethical and responsible utilisation of emerging technologies to advance human development. Furthermore, The Center for 4IR (Norrsken) is an initiative by the Norrsken Foundation and the Government of Sweden. It was launched in 2020 to accelerate the development and adoption of Fourth Industrial Revolution (4IR) technologies in Africa. The centre has four main pillars: research and development, talent development, policy dialogue, and public awareness. It aims to build the talent pool, develop the policy framework, and raise awareness of the 4IR in Africa. This work is essential for ensuring that all Africans benefit from the opportunities that the 4IR offers.

7.2.6 ECONOMIC SECTORS TO ADOPT AI TECHNOLOGY IN AFRICA

Africa should strengthen its information technology capacity in computer technology to drive innovation in AI software, hardware, and intelligence development. This can be accomplished by combining neural language processing and neural networks. For example, Africa can develop AI for multiple applications in speech recognition, image processing, deep learning, machine learning, and natural language processing. AI can potentially improve information technology through process automation, quality assurance, and service management.

African countries should also strengthen the finance industry by enhancing the adoption of self-learning algorithms to strengthen customer management and financial data organisation. This can be accomplished by improving financial advisory services such as AI-powered Robo-advisors, bionic advisory, trading, and digital marketing. Furthermore, improved customer interactions such as AI-enabled chatbots can enable personalised customer services, Chatbots are expected to reach US$142 billion by 2024 from US$2.8 billion in 2019, worldwide. Consequently, chatbots are enabling banking, healthcare, and retail sectors to up to US$11 billion a year by 2023.[303]

AI is also transforming the healthcare industry by tracking patients' health, online symptom checkers, virtual agents for hospitals, bionic pancreas for people living with diabetes, e-triage tools that predict health outcomes, tools that optimise hospital-bed management, and applications that assist with

[302] https://cortexlogic.com/2018/04/10/exciting-ai-developments-in-africa-and-beyond/.
[303] Ramesh, A., & Chawla, V. (2022). Chatbots in Marketing: A Literature Review Using Morphological and Co-Occurrence Analyses. Journal of Interactive Marketing, 57(3), 472–496. https://doi.org/10.1177/10949968221095549.

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paperwork. As such, AI is automating mundane and repetitive tasks for healthcare personnel. AI is also automating decision-making and enhancing supply chains by facilitating effective financial and administrative work. AI is also decreasing certain human elements, such as medical errors that are reportedly costing families over 200,000 people a year and over US$2 billion in additional expenses.[304]

AI is also enabling African countries to leverage insights from AI-powered wellness wearables to help with disease diagnostics. The health data being generated by wearables is helping with heart disease research, heart rate data, and sleep tracking. With the advent of AI-powered smart device usage, patients can share their data with their doctors to help diagnose and manage diseases, and doctors can easily create personalised treatment plans.

Transportation is observing the emergence of self-driving motor vehicles. As such, it is envisaged that by 2023 there will be 54 million self-driving cars on the road globally, up from 31 million in 2019. Furthermore, the usage of autonomous vehicles is significantly reducing logistics-related costs by approximately 30%.[305] This is accomplished using automated vehicle data to improve efficiencies such as tracking traffic, optimising delivery routes, and processing payments. Autonomous cars and lorries, self-organizing fleets, smart containers, and driverless taxis are some of the anticipated examples in the transportation industry.

AI is also having a major impact on the education sector in Africa. AI-powered systems can be used to personalise learning for individual students, provide feedback, and track progress. This can help students to learn more effectively and to achieve their full potential. AI is also being used to develop new educational tools and resources, such as virtual reality (VR) and augmented reality (AR) applications. These applications can provide students with immersive learning experiences that can help them to understand complex concepts more easily. In addition, AI is being used to improve the efficiency of educational systems by automating tasks such as grading assignments and managing student records.

The financial technology (fintech) sector is another area where AI is having a major impact. AI-powered systems can be used to automate tasks such as fraud detection, risk assessment, and customer service. This can help financial institutions to improve efficiency and reduce costs. AI is also being used to develop new financial products and services, such as mobile money and peer-to-peer lending. These products and services can help to improve financial inclusion and to provide access to financial services to people who previously did not have them.

The adoption of AI technology in these sectors has the potential to transform the African economy and improve the lives of millions of people. However, it is important to note that there are also challenges associated with the adoption of AI technology, such as the need for training and skills development, the need for data protection and privacy regulations, and the need to address potential biases in AI systems. Thus, despite these challenges, the adoption of AI technology in Africa is a promising development that has the potential to create new opportunities and improve the lives of millions of people.

7.3 STATUS UPDATE ON CURRENT TRENDS OF AI ECONOMIC ACTIVITIES

7.3.1 VENTURE CAPITAL PER COUNTRY IN AI-BASED SOLUTIONS IN AFRICA

AI-based participation in Africa remains limited as compared to North America which is observing more venture capital funding. This is due to several factors, including the lack of skilled AI talent in Africa, the high cost of developing and deploying AI solutions, and the lack of government support for AI initiatives. For example, North America observes more venture capital investment raised in a single

[304] https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_751599.pdf
[305] https://www.latimes.com/business/la-xpm-2014-jan-02-la-fi-hy-autos-ihs-autonomous-cars-study-20140102-story.html.

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day than in an entire year in South Africa.[306] The Southern African Venture Capital and Private Equity Association reported investments of approximately US$77 million in 2017 which were significantly lower than venture capital deals of approximately US$84.24 billion for the same period. This is an average of about US$115 million per morning.[307]

Despite these challenges, several African startup companies are using AI to solve some of the continent's most pressing problems. For example, AI is being used to improve healthcare delivery, increase agricultural productivity, combat climate change, and improve financial inclusion. As such, in 2023, there has been some progress in terms of increasing AI-based participation in Africa. For example, the African Development Bank has launched a US$100 million fund to support AI initiatives on the continent. These initiatives include supporting AI research and development, capacity building, and the commercialisation of AI solutions. Additionally, several technological hubs and accelerators have been established in Africa to help startup companies develop and deploy AI solutions.

However, there is still a long way to go before AI-based participation in Africa reaches parity with North America. To achieve this, African governments need to invest in AI education and training, and tech companies need to develop more affordable and accessible AI solutions. Further to this, the World Economic Forum launched the Africa Artificial Intelligence for Development (AI4D) initiative. The initiative aims to accelerate the adoption of AI for social and economic development in Africa. Additionally, the Rockefeller Foundation launched the Africa AI for Development Network in 2023. The network aims to connect African AI researchers, practitioners, and policymakers.

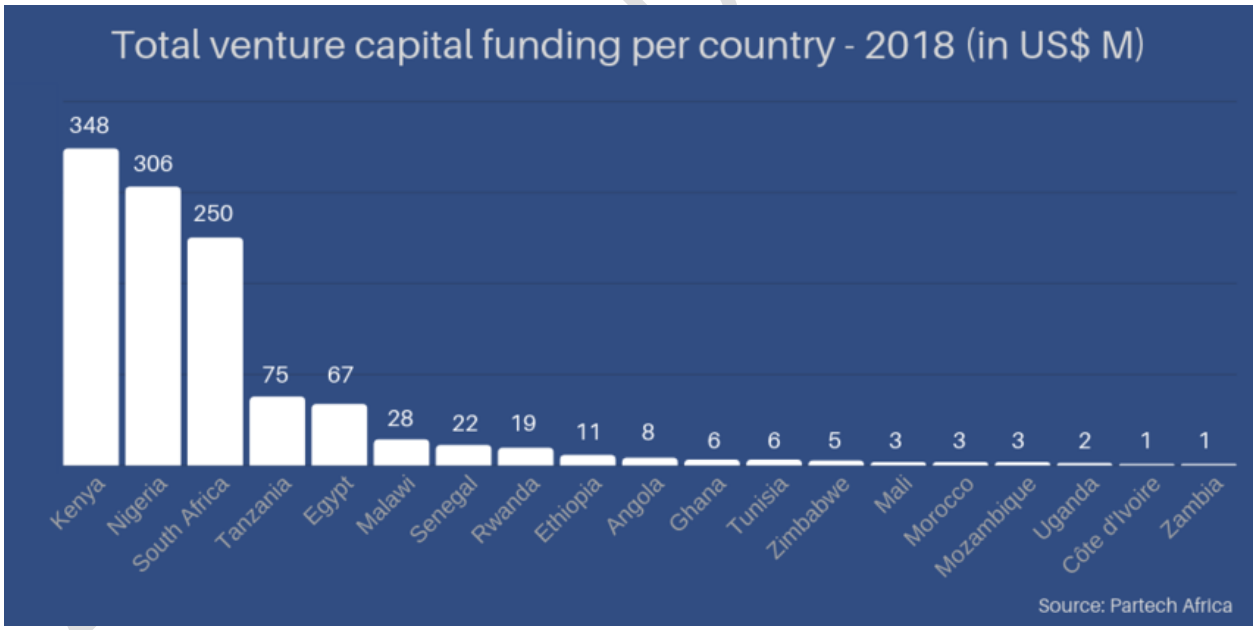

Figure 8.3. Total venture capital funding per country – 2018 (in US$ Million)

There have been some improvements since 2017 in capital investments towards AI-based solutions. However, in 2019 African investments were significantly leaning towards financial technologies. On the other hand, Nigeria has now exceeded South African and Kenyan investments towards AI-based solutions for financial technology solutions (Figure 9).[308] This is likely because Nigeria has a large and growing population and a growing middle class. This has created a large market for financial services and has made Nigeria an attractive market for AI-based financial technology solutions. Arguably, Africa is the regional powerhouse that has been substantively investing in greater than US$1 million.

[306] https://qz.com/africa/2175765/the-big-deal-vc-funding-in-africa-is-up-150-percent-from-q1-2021-to-q1-2022.
[307] https://techcrunch.com/2021/05/25/venture-capital-investment-in-africa-predicted-to-reach-a-record-high-this-year/.
[308] https://www.mckinsey.com/industries/financial-services/our-insights/fintech-in-africa-the-end-of-the-beginning.

Nevertheless, it is interesting to note that 5 start-up companies accounted for about 50% of the total investments that were made at this level.[309]

As a result, some startup companies were created within the financial technology. For example, Flutterwave is a payments company that allows businesses to accept payments from customers in Africa and around the world. Jumo is a microfinance company that provides loans to people in Africa who do not have access to traditional banking services. On the other hand, Cellulant is a mobile money company that allows people to send and receive money, and to make payments for goods and services using their mobile phones. Andela is a company that trains and hires software engineers in Africa. The Wave is a mobile money company that allows people to send and receive money, and to make payments for goods and services using their mobile phones.

These companies have raised significant amounts of funding from venture capital firms and are using AI to solve some of the continent's most pressing challenges. For example, Flutterwave is using AI to detect fraudulent transactions, and Jumo is using AI to assess the creditworthiness of borrowers. The success of these companies is a sign of the growing potential of AI in Africa. As such, AI continues to evolve, and Africa will likely see even more innovation and investment in AI-based solutions on the continent in the years to come.

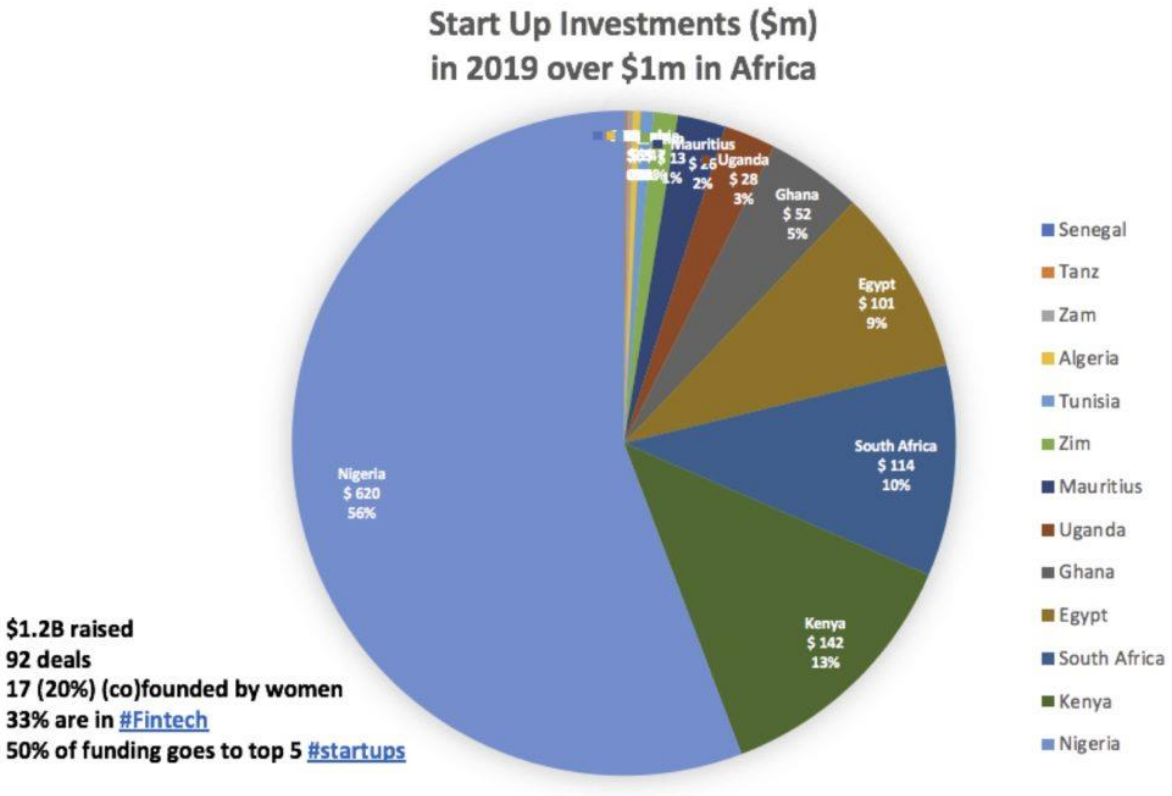

Figure 9. African Venture Capital Investment in US dollars in 2019 of at least US$1 million or more

There have been some venture capital firms that have invested in AI start-up companies across Africa. For example, a South African-based Knife Capital has invested in Data Prophet and Kalon Ventures which are focusing on FinChat Bot.[310] On the other hand, Tunisia's enterprise AI (AAI) start-up company called InstaDeep raised a US$7 million Series in 2019.[311] A private equity firm called Ethos has also raised approximately US$60 million to fund South African companies generating AI solutions based in.[312] Furthermore, the United Nations International Children's Emergency Fund (UNICEF) has

[309] https://pitchbook.com/media/press-releases/us-venture-capital-investment-reached-1309-billion-in-2018-surpassing-dot-com-era.
[310] https://www.avca-africa.org/media/2967/62644-avca-avca-venture-capital-in-africa-report-v13.pdf.
[311] https://www.itweb.co.za/content/KA3WwqdzyXg7rydZ.
[312] https://assets.bii.co.uk/wp-content/uploads/2008/06/25150837/Development-Report-2008.pdf.

put out a call for Data and AI solutions from African countries through its Innovation Fund. This funding is availing equity for free investments of between US$550,000 and US$990,000 in early-stage startup companies dealing with AI, data science, and machine learning solutions.[313]

For example, venture capital investment in AI start-up companies in Africa in 2023 includes Knife Capital. The Knife Capital is a South African venture capital firm that has invested in several AI start-up companies, including Data Prophet and Kalon Ventures. In 2023, Knife Capital raised US$100 million for its third fund, which will be used to invest in early-stage AI companies across Africa. On the other hand, InstaDeep, a Tunisian enterprise AI start-up company, has raised US$7 million in funding from investors such as Andreessen Horowitz and Mubadala Capital. InstaDeep is using AI to solve a variety of African challenges, including fraud detection, natural language processing, and robotics.

Ethos is a private equity firm that has raised US$60 million to fund South African companies generating AI solutions. Ethos has invested in several AI start-up companies, including Yoco, a payments company, and SweepSouth, a house cleaning company. Furthermore, UNICEF has put out a call for Data and AI solutions from African countries through its Innovation Fund. UNICEF is looking for early-stage start-up companies that are using AI to solve problems related to child protection, education, and health. UNICEF will provide equity-free investments of between US$550,000 and US$990,000 to selected companies.

Naspers have committed about US$270 million to fund back into South African technology businesses through an initiative called the Naspers Foundry.[314] This funding initiative was announced at the inaugural South Africa Investment Conference in 2018 to fund and support South African technology start-up companies seeking to address big societal needs. As such, Naspers Foundry is helping talented and ambitious South African technology entrepreneurs to develop and grow their businesses.[315]

The South African Small-and-Medium Enterprises Fund has completed its first year of investments in funding and supporting the development of entrepreneurship by investing about 50% of their capital into black-African-owned and managed businesses.[316] A further 25% is being invested in Indian and Coloured-owned and managed businesses. The remaining 25% of funding is being invested in businesses at the discretion of the fund manager. Typically, this foundational funding is helping South Africa grow a broader investment ecosystem to develop an enterprise value of more than US$60 million.[317]

In September 2019, Cirrus AI was launched at the AI Expo Africa to enhance the impacts of research in the application of AI in Africa.[318] This funding is supporting interdisciplinary cooperation between academic and industrial activities from around the world to bolster the application of AI technologies. Consequently, this is ensuring the transformative potential benefits of AI solutions around the continent. This is yielding inclusive participation in the dissemination of knowledge to conceptualize and develop the next generation of African-based AI research activities. In this way, the Cirrus Foundry and Cirrus Fund are bridging the gap that exists between academic research and industrial applications by turning a start-up idea or scientific research into a large-scale commercial application.

As of March 2023, the Cirrus AI fund has accumulated US$125 million in funding. The fund has invested in 25 AI companies in Africa and the companies that Cirrus AI has invested in are using AI to solve a variety of problems, including improving crop yields, and predicting crop diseases in agriculture. In healthcare, startup companies are using AI to diagnose diseases, develop new drugs, and improve patient care. Within financial services, companies are using AI to detect fraud, improve credit scoring, and provide financial services to people who do not have access to traditional banking services. In education, companies are using AI to personalise learning, provide feedback to students, and improve

[313] https://www.instadeep.com/2019/05/instadeep-raises-7-million-in-series-a-funding-to-power-enterprise-decision-making-with-ai/.
[314] https://www.southsouth-galaxy.org/wp-content/uploads/2021/01/China-Development-Report-on-South-South-Cooperation-2014-EN.pdf.
[315] https://www.bizcommunity.com/Article/196/708/183627.html.
[316] https://www.prosperafrica.gov/blog/investing-in-black-entrepreneurs-a-south-african-fund-leads-the-way/.
[317] https://ventureburn.com/2019/10/sa-sme-fund-to-be-one-of-biggest-institutional-investors/.
[318] https://aiexpoafrica.com/2020/01/06/artificial-intelligence-africa-will-2020-tipping-point-african-ai/.

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teacher training. Within logistics, companies are using AI to optimise supply chains, track shipments, and predict demand.

Fundamentally, the Cirrus AI fund is having a positive impact on the African AI ecosystem. The fund is helping to grow the number of AI start-up companies in Africa, attract top talent to the African AI ecosystem, develop new AI technologies that can be used to solve problems on the continent and promote the use of AI for socioeconomic development in Africa.

In December 2019, Xecced Ventures launched an African-focused AI venture capital fund of about US$100 million.[319] This fund is dedicated to investing in industrialisation-centric to fast-track the 4th industrial revolution (4IR). The fund is also leveraging AI in sustaining globally benchmarked operational efficiencies to facilitate resource mobilisation and investments into AI activities. This is also reducing travelling costs and bolstering AI-based investees' product innovation. Accordingly, Xecced Ventures is empowering 'Africa's 4IR-based businesses in South Africa and the rest of the African continent. Even though this collective total of funding is not as high as Silicon Valley, it is an encouraging start and initiative in Africa.[320]

However, as of March 2023, the Xecced Ventures fund has accumulated US$150 million in funding. As a result, the fund has invested in 15 AI companies in Africa. The companies that Xecced Ventures has invested in are using AI to solve a variety of challenges such as using AI to improve crop yields and predict crop diseases. They are also using AI to diagnose diseases, develop new drugs, and improve patient care. Some companies are using AI to detect fraud, improve credit scoring, and provide financial services to people who do not have access to traditional banking services. This includes using AI to personalise learning, provide feedback to students, and improve teacher training. In logistics, African companies are using AI to optimise supply chains, track shipments, and predict demand.

It is important to note that the total amount of funding available to AI start-up companies in Africa is still small compared to Silicon Valley. However, the amount of funding has increased significantly in recent years, and it is likely to continue to increase in the years to come. This is a positive development for the African AI ecosystem, as it will help to grow the number of AI start-up companies, attract top talent, and develop new AI technologies.

7.3.2 AI READINESS IN AFRICA TO COMMERCIALISE AI SOLUTIONS

In 2017, PricewaterhouseCoopers (PwC) reported the economic impact of AI on the economy of the world by 2030. It was reported that AI could heighten the global GDP by 14%, valued at approximately US$115.7 trillion. This was reported to be the biggest commercial opportunity for the global economy. With this potential, African countries should deliberately invest in AI technology so they can benefit from the resultant socioeconomic opportunities. As it is, African countries are barely investing and participating in AI activities. The limited opportunities that exist in AI technologies are substantively sponsored by international companies and developmental partners, other than the active participation of African governments. Thus, African countries are being challenged to invest towards AI-driven economic activities to benefit and address local and regional challenges across various socioeconomic developmental frameworks.

[319] https://ventureburn.com/2019/11/xecced-ventures-4thiria-fund/.
[320] https://www.brookings.edu/research/the-fourth-industrial-revolution-and-digitization-will-transform-africa-into-a-global-powerhouse/.

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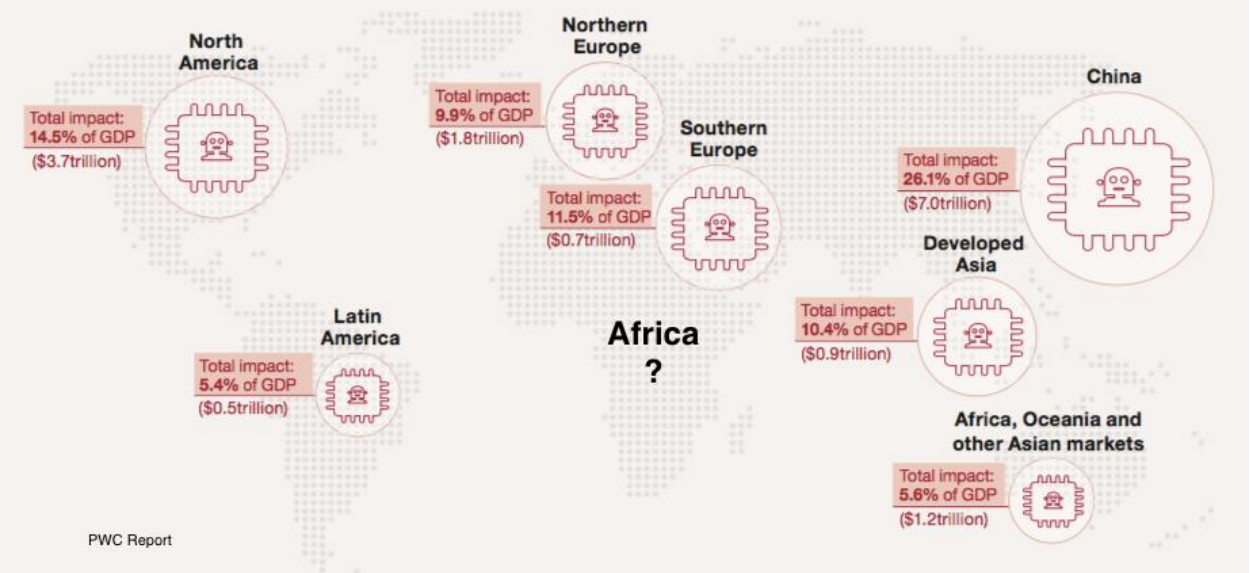

Figure 10. Total Impact of AI technologies on the GDP of global countries[321]

The PwC report also estimated that AI technology could potentially increase Africa's GDP of Africa, Oceania, and other Asian markets by about 5.6 %. This is estimated to be valued at approximately US$11.2 trillion.[322] This is exclusive to China and other developed Asian countries. Therefore, this demonstrates that Africa can significantly benefit economically from AI-based ventures. However, the 2019 Government AI Readiness Index reported that African countries are barely fairing evenly in the global indices. As it stands, there are no African countries that are placed in the top 50 positions. In addition, only 12 African countries out of the 54 countries on the list, are in the top 100. Particularly, the top 5 African governments placed on the list included Kenya, Tunisia, Mauritius, South Africa, and Ghana. These countries reflected the well-documented developments in various technology sectors of these countries. Of the bottom ten countries, seven are classified as Least Developed Countries.[323]

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[321] https://saabrds.com/how-much-will-ai-contribute-to-the-global-economy-and-the-industrial-market/#:~:text=PwC%20Global%20Artificial%20Intelligence%20Study,product%20enhancements%2C%20stimulating%20consumer%20demand.
[322] https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html.
[323] https://aiexpoafrica.com/2020/01/06/artificial-intelligence-africa-will-2020-tipping-point-african-ai/.

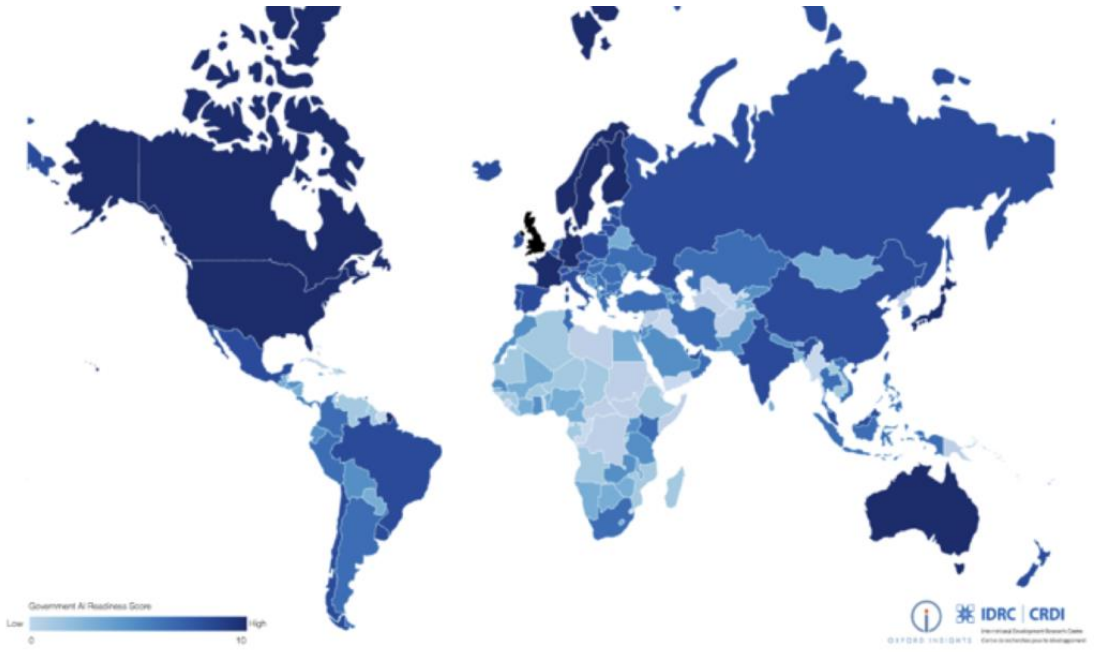

Figure 11. The African AI Landscape and success stories

Even though Africa's AI industry is still emerging, it has not immobilised some of Africa's most innovative start-up companies from developing solutions. This is demonstrating the opportunities and possibilities that AI technology can provide for Africa's economy. Consequently, multiple African countries have an inexperienced AI start-up scene and pan-African community-driven events. These initiatives include the AI Expo Africa and Deep Learning Indaba which are being established to help strengthen the AI community across the continent.

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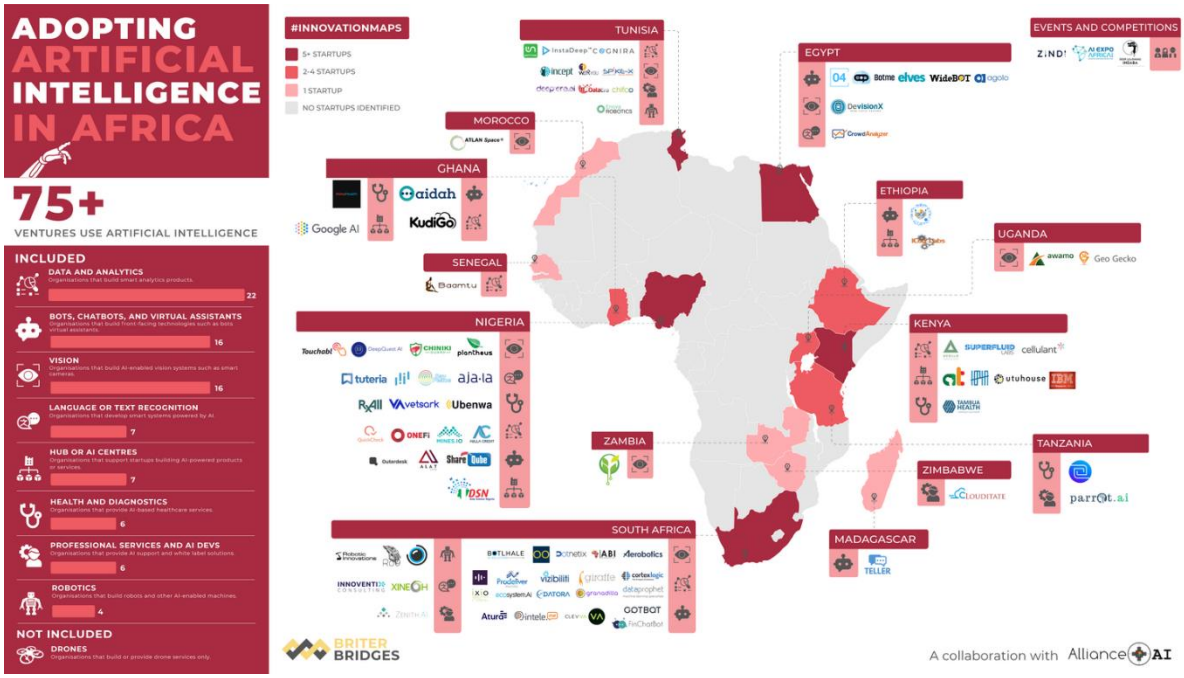

Figure 12. AI Start-up companies Africa via Briter Bridges & Alliance 4 AI[324]

For example, AI start-up companies in Africa include a South African Aerobotics company that uses drones and satellite imagery to collect data on crops, forests, and other land-based assets. This data can be used to improve crop yields, manage forests, and monitor environmental changes. Farmcrowdy is a Nigerian company that connects farmers with investors. Farmers can use the platform to get access to capital and to s their produce at a fair price. M-KOPA Solar is a Kenyan company that provides solar power to off-grid homes and businesses. Customers can pay for the solar system in installments, and they can use their mobile phones to make payments.

PesaCheck is a Kenyan company that uses fact-checking technology to verify information that is shared on social media. This helps to combat the spread of misinformation and fake news. Tumtum is a South African company that uses AI to personalise learning for students. The company's platform uses data to create personalised learning plans for each student. On the other hand, Briter Bridges and Alliance 4 AI are two organisations that are working to support the growth of AI start-up companies in Africa. Briter Bridges is a venture capital firm that invests in AI start-ups in Africa. Alliance 4 AI is a non-profit organisation that provides training and support to AI start-ups in Africa. As such, these organisations are helping to create a favourable environment for the growth of AI start-up companies in Africa. They are providing investment, training, and support to help these companies succeed.

The impact of AI start-up companies in Africa is still relatively small, but it is growing. As these companies continue to grow, they will have a larger impact on the continent. They will help to create jobs, boost economic growth, and improve the lives of Africans. Fundamentally, AI start-up companies are creating jobs in Africa. For example, Aerobotics employs over 100 people in South Africa, and Farmcrowdy employs over 100 people in Nigeria. In addition, AI start-up companies are boosting economic growth in Africa. For example, M-KOPA Solar has helped to bring solar power to over 500,000 homes and businesses in Kenya, and PesaCheck has helped to verify over 100,000 pieces of information on social media. Tumtum has helped to improve the learning outcomes of over 10,000 students in South Africa.

AI start-up companies are helping to address the continent's challenges in agriculture, healthcare, and education. For example, AI start-ups are developing new crop varieties that are resistant to pests and diseases, diagnosing diseases earlier and more accurately, and personalising learning for each student. Furthermore, AI start-up companies are helping to create new jobs and opportunities for Africans. As

[324] https://briterbridges.com/innovation-maps

AI technologies become more widely adopted, there will be a need for skilled AI workers. This could create new opportunities for Africans to get involved in the technology industry and contribute to the development of AI solutions that benefit the continent. AI start-up companies are also reducing poverty and inequality in Africa. By boosting economic growth and creating new jobs, AI start-up companies could help to lift people out of poverty and reduce inequality.

7.4 GOVERNMENTAL SUPPORT FOR CHANGE

The fiscal and monetary policy focuses on monetary management, trade, and investment to ensure that AI policy and implementation frameworks are prepared for the different socioeconomic of the 4th Industrial Revolution. As such, African governments are challenged to transform the potential of AI into a reality for their citizenry. Even though there are substantial challenges that should be overcome, there is a potential to strengthen the leadership role of Africa in AI by leveraging data science and management. The development of AI technologies is a global race as many countries around the world are competitively enhancing their AI capacities. As a result, various AI applications are already being deployed and utilised in the public and private sector space. Several countries around the world are already implementing AI solutions and actively tackling obstacles to leveraging the significant AI benefits.[325]

The International Data Corporation estimated that global spending on cognitive and AI systems reached about US$19.1 billion in 2018. This was an increase of 54.2% over the amount that was spent in 2017. It was observed that in 2018, the retail sector surpassed the banking industry by assuming industrial leadership in AI spending. As a result, the retail industry invested approximately US$3.4 billion towards AI technologies including automated threat intelligence and prevention systems, fraud analysis, investigation, programme advisors, and recommendation systems.

Countries around the world are increasingly becoming aware of the potential socioeconomic benefits of cultivating, fostering, implementing, and deploying AI technologies. As a result, these countries are actively and deliberately developing enabling AI policy frameworks to boost and promote their AI ecosystems. Many global governments are actively facilitating the development of AI in their country in the form of national strategies to support research, development, and innovation, and the allocation of funds to realise the deployment of commercial and industrial AI solutions.

For example, Canada has created the Pan-Canadian AI Strategy to leverage a robust business environment and build high-quality human capital in AI technology so to attract global players and drive development. This strategy is also providing targeted financial support for start-up companies and human capital retention. There is also a development of global thought leadership on the economic, ethical, policy, and legal implications of AI to enhance responsible AI.[326]

China has created the Next Generation AI Development Plan to pursue a massive government approach to leverage its economies of scale to dominate the AI market. As a result, ambitious quantitative targets for market growth across sectors and sizeable state support are being implemented. China is also using early government adoption of services to promote development, especially in healthcare, education, and security. In contrast, India has a National Strategy for AI that is focused on building upon comparative strengths to develop high-impact solutions in key niches. It is also focused on attracting global technology partners to conduct research and develop applications tailored to national needs.

Mexico's AI Strategy Mexico 2018 is promoting discussions across the government and private sectors to identify use cases, needs, and best practices of AI technology in socioeconomic development and growth. This includes utilising public-private partnerships to enhance public services and citizen

[325] https://www.up.ac.za/media/shared/7/ZP_Files/ai-for-africa.zp165664.pdf
[326] https://www.canada.ca/en/innovation-science-economic-development/news/2022/06/government-of-canada-launches-second-phase-of-the-pan-canadian-artificial-intelligence-strategy.html.

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participation through AI technology.[327] The United Kingdom's AI Sector Deal is facilitating agreements on joint investments and discussions on policy measures with the private sector. The strategy is also focusing on attracting talent and promoting data sharing and piloting solutions in partnership with global companies to improve public services.[328] The United Arab Emirates AI Strategy is prioritising the development of AI technology at the highest level of political focus and enhancing investments in skills training for students and workers.[329] Remarkably, all these policy plans on AI technology are enhancing the economic impact of AI technology in their development and growth.[330]

Therefore, for AI to have a significant impact on the continent, African countries should focus on areas where AI can have a big impact on the lives of citizens, such as agriculture, healthcare, and education. For example, AI can be used to improve crop yields, predict crop diseases, and manage pests and diseases. This can be accomplished by developing new crop varieties that are resistant to pests and diseases. African countries can also use data to create personalised learning plans for each farmer. This can help farmers monitor crop conditions in real-time and provide early warnings of potential problems and further optimise the use of water and other resources.

AI can also be used to diagnose diseases, develop new drugs, and improve patient care. For example, AI can be used to develop systems that can automatically detect diseases from images, use data to personalise treatment plans for each patient, develop new drugs that are more effective and less toxic, monitor patients' health conditions remotely and provide early warnings of potential problems.

In education, AI can be used to personalise learning, provide feedback to students, and improve teacher training. For example, AI can be used to develop systems that can automatically generate personalised learning plans for each student, provide feedback to students on their work, use data to improve teacher training and automate tasks such as grading and marking.

By focusing on these areas, African countries can use AI to improve the lives of their citizens and boost economic growth. This can be accomplished by focusing on areas where AI can have a big impact. This includes identifying the specific needs of their citizens such as the most pressing challenges that African countries are facing and identifying the areas where AI could have the biggest impact. This requires African countries to develop a plan for how to use AI to address these needs. This plan should include a timeline for implementation, as well as a budget.

African countries should also partner with international organisations and businesses. Several international organisations and businesses are working to develop and deploy AI solutions in Africa. Therefore, by partnering with these organisations, African countries can save time and money.

African countries should also invest in education and training. However, to develop a strong AI workforce, African countries need to invest in education and training. This includes providing students with access to AI courses and programmes, as well as training teachers on how to use AI in the classroom. This includes creating a supportive environment for AI innovation. This includes creating a regulatory framework that encourages AI development, as well as providing access to data and computing resources.

7.5 PRIORITISING FUNDS FOR AI SOLUTION DEPLOYMENT TO PROMOTE AFRICA'S SOCIOECONOMIC DEVELOPMENT

AI is a rapidly developing technology with the potential to revolutionise many aspects of our lives. In Africa, AI has the potential to be a powerful tool for socioeconomic development. However, to realise

[327] https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2021%2Fdata%2FpolicyInitiatives%2F26703.
[328] https://www.oecd.org/mcm/Policy-Framework-for-Gender-Sensitive-Public-Governance.pdf.
[329] https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/government-services-and-digital-transformation/uae-strategy-for-artificial-intelligence.
[330] https://ai.gov.ae/wp-content/uploads/2021/07/UAE-National-Strategy-for-Artificial-Intelligence-2031.pdf.

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this potential, African governments need to prioritise the allocation of adequate funds to promote the development and deployment of AI solutions.

There are many ways in which AI can be used to promote socioeconomic development in Africa. For example, AI can be used to improve healthcare, education, agriculture, and transportation. In healthcare, AI can be used to develop new diagnostic tools and treatments, improve the efficiency of medical care, and reduce the cost of healthcare. In education, AI can be used to personalise learning, provide feedback to students, and make education more accessible to everyone. In agriculture, AI can be used to improve crop yields, reduce food waste, and make farming more sustainable. In transportation, AI can be used to improve traffic management, reduce accidents, and make transportation more efficient.

By prioritising the allocation of adequate funds to promote the development and deployment of AI solutions, African governments can help to ensure that this technology is used to benefit all Africans. For examples of the impact of investments in AI solutions include Kenya's AI-powered malaria diagnosis application called mPedigree to reduce malaria-related deaths by 25%. In Nigeria, the AI-powered crop yield prediction tool Farmcrowdy has helped farmers to increase their yields by 20%. In South Africa, the AI-powered illegal mining detection system MineSense has helped to reduce illegal mining by 50%.

These are just a few examples of the many ways in which AI is already having a positive impact on socioeconomic development in Africa. As AI technology continues to develop, Africa will likely see even more impressive results in the years to come. However, it is important to note that AI is not a magic bullet. It is a tool that can be used for good or for bad. It is up to African governments to ensure that AI is used responsibly and ethically. Furthermore, the African governments need to put in place policies and regulations that will protect people from the potential negative impacts of AI. As such, AI has the potential to be a powerful tool for socioeconomic development in Africa. However, African governments should prioritise the allocation of adequate funds to promote the development and deployment of AI solutions. The African governments also need to put in place policies and regulations that will protect people from the potential negative impacts of AI.

7.5.1 STRATEGIC POLICY FRAMEWORKS AND GUIDING PRINCIPLES TO STRENGTHEN THE AI ECONOMY

The most applicable AI solutions for fiscal and economic policy require algorithms suitable for fiscal and monitoring policy. Such algorithms can enable the African government to develop good and fair taxation regimes to spur and strengthen economic growth. The best policy development and implementation should constitute evidence-based advisory regimes from the African citizenry. This will help the African people span from poverty and effectively interact with the economic sector. In addition, the measure of the economic development of African countries depends on how the economy performs and benefits citizens by providing essential services. Therefore, gathering data should be pursued to enable African countries to evaluate the performance of each socioeconomic sector. This will subsequently inform the policy of regimes of taxation, supply, and finance.

AI is well-positioned to improve businesses and banking by automating processes. This is enabled by enhancing the capacity to export data and learning from experience to influence fiscal policy and champion intelligent policies. The guiding principles include economic growth, inclusiveness, and strong infrastructural capacity. This is prudent if the fiscal and monetary policies can promote growth, enhance taxation to enable growth capital, create an enabling environment, and enhance job creation. Furthermore, AI can also foster an economic policymaking ecosystem and integrate AI into digital strategies effectively by strengthening data collection and management systems. Data management remains essential because it is required to make AI-enabled banking and financial management. Therefore, the banking institution may expose its data management to enable governments and banking institutions to enable taxation and payments. Therefore, there is a need to harmonise how data can be

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shared and managed between banking institutions and African governments through effective monetary policy frameworks.

African countries should also create a culture where AI-enabled technologies and policies can thrive by broadening and changing the culture, perception, and mindset against AI-generated technologies. Thus, the implementation and consumption of monetary and fiscal AI-enabled technologies demand consorted awareness of the public. This can be accomplished by training and exposing the benefits of AI-enabled policies for fiscal and monetary frameworks. Furthermore, Africa's education curriculum should integrate AI skills development and capacity strengthening across the primary, secondary, and tertiary schools of training, irrespective of their educational field. This will create an AI culture within the private and public sectors. As a result, this will enable easier adoption of AI technology and enable buy-in from various stakeholders towards AI strategies at national, regional, and continental levels.

African countries should also formulate efficient indicators of each economic sector to inform their education, manufacturing, health, agriculture, food production, and mining, among others. This can help indicate the citizenry's welfare and fiscal stability. This can be accomplished by collecting adequate data across these economic sectors. However, this remains difficult in Africa as there are limited digital devices and survey gadgets to enable mobile-based surveys. Thus, there is a need to formulate adequate sensor networks in manufacturing to strengthen their financial capacity and digital networks. However, to be more accommodating and strengthen local participation, African countries should collect data from their citizenry by using vocal and vernacular local languages, utilise cheap mobile devices cost-effective networks, and inexpensive data rates.

The monetary policy such as the supply of money in Africa's circulation should not only respond to Africa's socioeconomic and political history but also learn from the current developments. For example, AI is disrupting business models by introducing new digital intelligence business models. However, this will require new ways of thinking about monetary policies such as digital sovereignty and strategic autonomy. For instance, the European Union has responded by instituting regulatory measures to address such issues as taxation, digital markets, and digital services. Particularly, the African Continental Free Trade Agreement is a good starting point towards a single market to strengthen its political urgency and strategic autonomy.

Some socioeconomic situations and indicators may suggest that the economy is struggling. Such situations and indicators require adequate data that may usefully enhance the understanding to change the fiscal and business models. Unfortunately, developed nations continue to influence how the African continent can process its data across the African continent. However, to correct this, African countries may require consolidated partnerships to enhance Africa's data management systems. This can help establish reliable data and formulate better data processing systems to enhance economic activities such as logistics and transportation, and effectively address climate change impacts. To this end, African countries should develop data management infrastructure to better position data management systems and address the pandemic-induced challenges.

However, African institutions should ensure a clear understanding of the nature of the AI-enabled technology needed to optimise the socioeconomic solutions and reflect usefulness to Africa's small-to-medium enterprises within the informal economic sector. African countries should also address current policy gaps that are creating risks against using AI for economic policymaking, particularly data security and privacy. This includes formulating the most appropriate approach and theory of change to open-source and public goods in AI for economic policymaking. This includes considerations on enabling AI economic policymaking to accelerate digital skills development founded on Africa's AI principles.

7.5.2 DATA-RELATED INITIATIVES AND PARTNERSHIPS TO STRENGTHEN AI ECONOMIC ACTIVITIES

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Data-related initiatives and partnerships can be leveraged to create applicable data for use in economic activities. As such, Data Science Africa is providing a forum for scientists, academia, innovators, and SMEs to solve industrial challenges. This is enabling data that is not necessarily readily available in the AI space. In today's digital age, data has become a crucial resource for businesses and governments alike. With the advent of new technologies and tools, organisations can now collect and analyse vast amounts of data to gain valuable insights into customer behaviour, market trends, and more. As a result, data-related initiatives and partnerships have become increasingly important for creating applicable data that can be used in economic activities. By collaborating with other organisations and leveraging data-related initiatives, businesses and governments can gather and analyse information to make more informed decisions and drive economic growth.

7.5.3 EFFORTS OF AFRICAN GOVERNMENT IN INVESTING IN AI COMPANIES

African governments have a crucial role to play in supporting the advancement of AI in their countries. The development of AI has the potential to create jobs, drive economic growth, and improve the standard of living across the continent. One way that African governments can support AI development is through funding initiatives. There are several funding mechanisms that African governments can utilise to support the growth and development of AI. These include government grants, tax incentives, public-private partnerships, venture capital, incubators and accelerators, and procurement and investment in local AI companies and products.

Government grants are an important source of funding for companies, research institutions, and start-up companies working on AI projects. Governments can provide financial assistance to these entities through grants and funding schemes. This can help to cover the costs of research and development, equipment, and personnel, among other expenses. Another way that African governments can support the growth of AI is by providing tax incentives to companies that invest in AI research and development, and to those that adopt AI technologies in their operations. This can encourage companies to invest in AI and adopt new technologies, which can lead to increased innovation and productivity.

Public-private partnerships are another way that African governments can support AI development. By collaborating with private companies and investors, governments can provide funding for AI projects and start-up companies. This can help to bring together the expertise of both the public and private sectors, leading to more effective and innovative solutions. Furthermore, African governments can also create or fund venture capital firms that invest in AI start-up companies and well-established companies. Venture capital firms provide funding to start-up companies in exchange for equity in the company. By creating or funding venture capital firms that specialize in AI, governments can help to provide funding to start-up companies that might not otherwise have access to capital.

Incubators and accelerators are also important mechanisms for supporting AI start-up companies and companies. These programmes provide support to start-up companies, including mentorship, funding, and access to resources. By creating or funding incubators and accelerators, governments can help to support the growth and development of AI start-up companies and companies. As such, African governments can support AI development by procuring and investing in local AI companies and products. By purchasing AI products and services from local companies, governments can help to support the growth of the local AI industry. This can also help to create jobs and drive economic growth in the region.

African governments have several funding mechanisms at their disposal to support the growth and development of AI in their countries. By providing funding through government grants, tax incentives, public-private partnerships, venture capital, incubators and accelerators, and procurement and investment in local AI companies and products, governments can help to create a thriving AI ecosystem that benefits the entire continent.

7.5.4 ENHANCING SUSTAINABLE AND INCLUSIVE PARTNERSHIPS TO INFLUENCE AI ECONOMIC ACTIVITIES

African countries such as Ghana are progressively establishing initiatives and engagements to ensure the generation of adequate data to champion and help investors, businesses, and governments integrate their socioeconomic systems. On the other hand, data commissioning and sharing can enable organisations to deliver on AI systems for AI and help other stakeholders formulate initiatives to address the gap and ensure adoption. Additionally, many African countries are even taking lessons from India's digital transformations, particularly India's platforms to enhance digital identity and financial services. As global development agencies support these efforts, it remains essential and critical that adequate attention is paid to the institutional capacities and governance frameworks for governing such platforms.

Furthermore, African countries should also consider and accommodate that data sharing involves competition between various competitive businesses and institutions. Therefore, the various players, end-users, and innovators should consider competitive proprietary ownership to address suspicion and data commissioning. Fundamentally, data protection and reward regimes should be regulated to positively influence the sharing systems and law enforcement and enhance a positive data protection law environment. Such regulatory enforcement can lead to a more enabling environment where the various stakeholders can share.

African countries should also address the policy gaps and challenges that cause non-participatory relationships in policymaking and implementation. This can guide the policy gaps concerning usage and policy management with third parties. As it stands, data sharing remains narrow in agriculture, thereby, limiting market gains. The relevant data is also insufficient and enhancing data sharing can compel data-sharing programmes in the process of data discovery and transition beyond governmental institutional knowledge collaboration. For example, Kenya is focusing more on budgeting than planning and this is disadvantaging implementation capacities. However, availing this data can enhance planning within the private sector and private sector, other than being responsive and passive.

7.5.5 PUBLIC PROCUREMENT

Public procurement can play a significant role in the development of AI economy in African countries. Here are a few reasons why:

Stimulate demand: Public procurement can help to stimulate demand for AI products and services in African countries. By using their purchasing power to buy AI products and services, governments can encourage the growth of the AI industry and create a market for local companies to sell their AI solutions. Indeed, Public procurement can stimulate demand for AI products and services in African countries because it provides a guaranteed market for local AI companies. When governments in African countries purchase AI products and services, they create a reliable customer base that can incentivise local AI companies to invest in developing AI solutions that meet the needs of the public sector. This demand can then create a ripple effect by attracting more investors and customers to the local AI industry, further driving growth and innovation.

Moreover, public procurement can also serve as a signal to private-sector companies that there is a market for AI solutions in the public sector. This signal can encourage private sector companies to enter the market, which can lead to increased competition, innovation, and ultimately, lower prices for AI products and services.

In addition, public procurement can also help to build trust in the AI industry by providing a stamp of approval from government agencies. This stamp of approval can reassure potential customers that the AI products and services being offered are reliable and effective, which can further stimulate demand for AI solutions.

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Public procurement can stimulate demand for AI products and services in African countries by providing a reliable customer base, encouraging private sector companies to enter the market, and building trust in the AI industry. This can lead to increased growth and innovation in the local AI industry, as well as better AI solutions that meet the needs of the public sector.

Encourage innovation: By issuing tenders for innovative AI projects, governments in African countries can encourage local companies to develop new and innovative technologies that are tailored to the needs of the public sector. This demand can incentivise local AI companies to invest in research and development (R&D) to create new and innovative AI solutions that can meet the requirements of the tender. This can lead to the creation of new AI technologies and methods that are tailored to the needs of the public sector and can be further developed for commercial use.

Besides, public procurement can promote collaboration between the public and private sectors, as well as academia and research institutions. Through these collaborations, knowledge and expertise can be shared, which can lead to new insights and innovative solutions to complex problems. This can result in new partnerships between different stakeholders in the AI industry, which can encourage further investment in R&D and foster a culture of innovation in the industry.

Furthermore, public procurement can provide funding for AI projects that have a high innovation potential. By investing in these projects, governments can encourage local AI companies to take risks and explore new ideas that may not have been possible otherwise. This can lead to the creation of innovative AI products and services that can help to solve pressing societal challenges in African countries.

Thus, public procurement can encourage innovation in the AI industry in African countries by creating a demand for innovative solutions, promoting collaboration between different stakeholders in the industry, and providing funding for high-potential AI projects. This can lead to the creation of new and innovative AI technologies and methods that can drive growth and development in the industry.

Foster competitiveness: Through collaborations with local AI companies, governments can help to foster a competitive AI industry in African countries, which can lead to job creation, economic growth, and the development of local talent. This can create a level playing field for local AI companies to compete in.

Governments in African countries can set aside a portion of their public procurement budget for local companies, which can help to create a level playing field for local AI companies to compete with foreign companies. This can lead to the development of a robust and competitive local AI industry.

Besides, governments can promote fair competition by implementing transparent and objective procurement processes, which can help to prevent favouritism or bias towards certain companies. This can help to ensure that all companies have an equal opportunity to compete for government contracts. Furthermore, public procurement can encourage collaboration between local AI companies, which can help to build a stronger and more competitive AI industry. Collaboration can lead to the development of new products and services, as well as the sharing of knowledge and expertise.

As mentioned earlier, public procurement can encourage innovation in the AI industry, which can lead to the creation of new and innovative products and services. This can help local AI companies to differentiate themselves from their competitors and gain a competitive advantage. In addition, by supporting the development of local AI companies, public procurement can also help to develop local talent in the AI industry. This can lead to the creation of a pool of skilled AI professionals, which can help to strengthen the local AI industry and increase competitiveness.

Public procurement can foster competitiveness in the AI industry in African countries by creating a level playing field, promoting fair competition, encouraging collaboration, innovation, and the development of local talent. This can lead to the creation of a robust and competitive local AI industry that can drive economic growth and development.

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Address social challenges: AI can be used to address social challenges in African countries, such as improving healthcare, reducing poverty, and promoting sustainable development. Public procurement can help to support these initiatives by providing funding for AI projects that have a social impact. In particular, public procurement can help address social challenges in African countries by leveraging AI to improve public services and outcomes. Here are some priority sectors in which public procurement can help to develop AI solutions.

Public procurement can be used to acquire AI-based solutions that improve healthcare outcomes in African countries. AI-powered medical diagnosis tools can help to identify diseases and conditions earlier and more accurately, while AI-powered drug discovery tools can help to speed up the development of new treatments for diseases.

Public procurement can also be used to acquire AI-based solutions that improve education outcomes in African countries. AI-powered tools can help to personalize learning and provide targeted support to students who need it most. They can also help to identify and address gaps in student learning and improve teacher effectiveness.

Furthermore, public procurement can be used to acquire AI-based solutions that improve public safety outcomes in African countries. AI-powered video surveillance systems can help to detect and prevent crime, while AI-powered predictive analytics can help to identify high-risk areas and individuals. Moreover, public procurement can also be used to acquire AI-based solutions that help to reduce poverty in African countries. AI-powered job matching tools can help to connect job seekers with job opportunities, while AI-powered credit scoring tools can help to expand access to finance for individuals and small businesses.

Besides, public procurement can be used to acquire AI-based solutions that help to address environmental challenges in African countries. AI-powered climate modeling tools can help to predict and mitigate the impacts of climate change, while AI-powered precision agriculture tools can help to improve crop yields and reduce the use of pesticides. As such, public procurement can address social challenges in African countries by leveraging AI to improve public services and outcomes. By investing in AI-based solutions, governments can help to improve the lives of their citizens, promote economic growth and development, and tackle some of the most pressing challenges facing African societies today.

Enhance data access: Governments in African countries possess a vast amount of data that could be useful in training AI models and developing AI applications that have societal benefits. One way to expedite the growth of the AI industry in African countries is by utilizing this data through procurement. Procurement can help to enhance data access by mandating that suppliers grant access to the data generated by AI-based solutions obtained by the government.

Provisions can be included in procurement contracts that demand suppliers to share the data generated by AI-based solutions with the government. This would ensure that the government has the data it requires to make well-informed decisions and improve public services. Procurement can also facilitate open data initiatives in African countries. The government can demand that suppliers follow open data standards and make data accessible to the public, promoting accountability and transparency.

Public procurement can enhance the quality of data that is available to the government by mandating that suppliers share their data. This would result in better decision-making, more precise analysis, and improved public services. Additionally, procurement can promote data-driven innovation by making data accessible to local AI companies and researchers, resulting in the development of new products and services, and promoting economic growth.

Procurement can also promote collaboration among government agencies, local AI companies, and other stakeholders by requiring suppliers to share data. This would lead to new partnerships and initiatives that leverage data to improve public services and outcomes. Ultimately, procurement can enhance data access in African countries by mandating data sharing, promoting open data initiatives,

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improving data quality, facilitating data-driven innovation, and promoting collaboration. By improving data access, procurement can help to promote transparency, accountability, and innovation in the AI industry in African countries.

In summary, public procurement can play an important role in the development of the AI economy in African countries. By investing in AI-based solutions, governments can stimulate demand for AI, encourage innovation, foster competitiveness, address social challenges, and enhance data access. Public procurement can help to improve public services and outcomes, promote economic growth and development, and address some of the most pressing challenges facing African societies today. Overall, public procurement can help to position African countries as leaders in the AI industry and create a more prosperous and equitable future for all citizens.

7.6 EQUITY INVESTMENTS

Many countries are the world are actively making strides to enhance their continued AI economy development and growth by incorporating AI into their policy and legislative frameworks. However, African countries are lagging significantly in organising, formalising, and institutionalizing AI activities. Therefore, there is an urgent need for African countries to invest in AI ventures. This can ensure that Africa's AI pursuits do not slip further behind in its development and economic outputs. Thus, if African countries are to hasten and fast-track their development, embracing and harnessing the AI economic opportunities for growth should be prioritised.

7.6.1 EQUITY INVESTMENTS ONTO AI ECONOMIC ACTIVITIES

The present landscape is demonstrating that private companies and private investors are actively investing on all digital fronts, including AI, rather than African governments. So far, anywhere between US$25 billion and US$40 billion has been invested in mergers and acquisitions, private equity, grants, and seed funding.[331] However, despite the significant equity being invested into AI technology around the world, there is limited investment being directed towards AI in Africa. Figure 11 is demonstrating the investments towards advanced technologies, and clearly, the emerging markets have committed a minor share of the global investments, where China and India are the exceptions.

African countries should also consider an AI Fund that identifies and invests in businesses that can benefit disproportionately from AI. This AI Fund can competitively work with companies to transform and adapt existing businesses into AI-based institutions. This can enhance the capability of companies to comprehensively upgrade their organisational design, strategic planning, resourcing, use of data, technology, analytics, incentives, culture, execution, change management, and people management.

This AI Fund can also focus on enhancing algorithmic decision-making capacities and mechanisms for businesses and institutions. This can be accomplished by investing capital in growth equity by targeting companies with strong prospects, low business model risk, established profitability, and positive cash flows. Further to this, African countries can invest their capital in earlier-stage growth equity.[332] These are businesses that are demonstrating the potential for strong revenue growth, in existence for less than 5 years, and potentially not profitable yet, but with some business model risk.

[331] https://www.mtn.com/wp-content/uploads/2022/02/MTN-Sustainability-report.pdf.
[332] https://ethos.co.za/communications/ethos-launches-ai-fund-to-focus-on-digital-industrial-revolution/.

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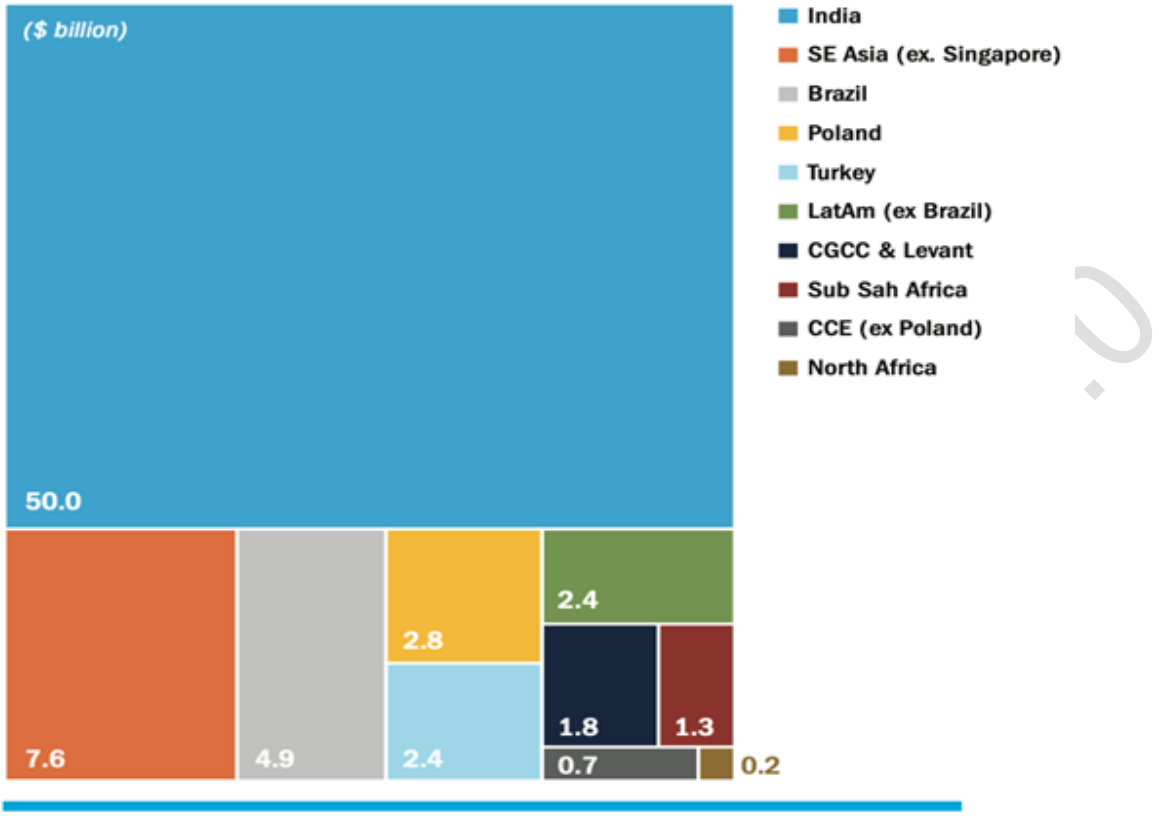

Figure 12. Emerging markets venture capital investment between 2008 – 2017 (ex-China) (Source: Pitchbook 2019)

To strengthen the success rate of AI ventures in Africa, African countries should create an enabling environment to do business. For example, early-stage AI start-up companies are struggling to access good valuations.[333] For example, in a single morning in North America, more venture capital funding is raised than in a whole year in South Africa. The Southern African Venture Capital and Private Equity Association reported that South Africa's venture capital investments were approximately US$77 million in 2017 compared to approximately US$84.24 billion for the same period in the US, with an average of US$115 million per morning.[334]

In 2022, venture capital investments in South Africa reached US$1.3 billion, up from US$77 million in 2017. This represents a compound annual growth rate (CAGR) of 42%. Most venture capital investments in South Africa are in the technology sector, with a focus on financial technology, healthcare technology, and education technology. However, in the same period, venture capital investments in the United States of America reached US$621 billion, up from US$84.24 billion in 2017. This represents a CAGR of 25%. Most venture capital investments in the United States are in the technology sector, with a focus on software, artificial intelligence, and blockchain.

This demonstrates the significant gap between venture capital investments in South Africa and the United States of America. This is due to several factors such as the limited pool of potential investors in Africa. For instance, in South Africa, there is a smaller population and economy than in the United States of America, translating into a smaller pool of potential investors. Furthermore, there is a lower level of risk appetite in Africa. For example, investors in South Africa are generally more risk-averse than investors in the United States of America due to factors such as the history of economic instability.

[333] Jo-Ann Suchard, Mark Humphery-Jenner, Xiaping Cao, Government ownership and Venture Capital in China, Journal of Banking & Finance, Volume 129, 2021,106164, ISSN 0378-4266, https://doi.org/10.1016/j.jbankfin.2021.106164.

[334] https://grain.org/media/W1siZiIsIjIwMTIvMDIvMjIvMTBfMjZfMzlfNTc5X0dSQUlOX0xhbmRfZ3JhYl9kZWFsc19KYW5fMjAxMi5wZGYiXV0

Additionally, the limited infrastructure is another factor impeding venture capital investment. As such, African countries lack the same level of infrastructure as the United States of America, thereby, making it more difficult for startup companies to operate and grow.

However, despite these challenges, several promising start-up companies in Africa are using AI to solve real-world challenges. These startup companies are attracting attention from international investors, and there is a growing sense of optimism about the future of AI in Africa. For example, Aira AI is a company that is using AI to provide remote assistance to people with disabilities. FuseIT is a company that is using AI to improve the efficiency of businesses. Nura is a company that is using AI to develop personalised hearing aids. These few examples of the many AI start-up companies that are making a difference in Africa to make AI ecosystem in Africa continue to emerge and grow.

More unfavourable conditions are negatively impacting African businesses, especially AI ventures. As a result, African venture capital investors, especially South African venture capital, are much more risk-averse than their Silicon Valley counterparts. In the US, venture capitalists are more likely to invest in high-risk innovation ideas than African venture investors. For example, South African investors will typically evade start-up companies that do not have an established cash flow and firm traction. This is different to Silicon Valley where start-up companies can sell an idea. This model works because most start-up companies may not have a solid business plan until the product has been properly launched in the market. This works because it is only after the start-up company has received the initial feedback from customers that they can reflect on and subsequently create a product-market fit. In contrast, North American venture capital put a very high premium on innovative products and ideas.

Furthermore, most start-up companies in Africa do not have the in-house expertise to sufficiently appraise the existing AI solutions. This is a mismatch because African venture capital is predominately constituted of professionals with a banking background as opposed to the investors who predominately have a technology and engineering background in Silicon Valley. This puts the burden on the innovators to explain the technology subjects, even before discussing innovative ideas.

Seeking funding from abroad is often a difficult option for African innovators because the negative reports on the socioeconomic and political conditions of many African countries may discourage the participation of investors in the African markets.[335] Furthermore, since venture capital investors are far from innovation, it turns to discourage their participation. This is because early-stage investors tend to prefer start-up companies that are closer to them and easily accessible. For example, a San Francisco-based venture capital investor would avoid investing in a start-up company in Phoenix or New York, even though all these cities are in the USA. By having the start-up company close by, the investors can closely monitor their activities much more regularly. This is even more complicated in a company that is not even on the continent. Hence, the limited abroad venture capital investments observed between African and abroad investors.

Additionally, recruiting AI talent is an ongoing pressure point for African AI start-up companies. This is because super-smart data scientists are vital to successfully establishing and maintaining AI companies. Yet, AI skills are in short supply across the African continent. Most universities in Europe and North America have positively responded to the challenges and opportunities of data science. They have since established new institutes, departments, and degree programmes in the field to enhance their skills capacity. However, Africa's educational institutions have only recently started narrowing this skills gap. Furthermore, there is still more work that should be implemented in Africa to start observing trained data scientists. There should be efforts within tertiary institutions to promote data scientists as a career choice.

There is also a need to encourage the private to fully appreciate the benefits and opportunities of AI. Particularly, an AI sales pitch in South Africa requires a significant educational component. Even though the large corporation is generally recognising the importance of AI, their interest is mostly in the information-gathering or experimentation phases. There are limited efforts on adopting AI-based

[335] https://www.brookings.edu/testimonies/us-trade-and-investment-in-africa/.

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solutions on an industrial scale. Further to this, most African companies, especially in South Africa, often pursue their own in-house AI solutions, however, these in-house initiatives rarely proceed into the implementation phase.

There has been an observed willingness to adopt AI solutions in the retail sector. This is because retailers' transaction data supported by AI algorithms help the traders manoeuvre this highly competitive industry. Most African retailers are focused on customer service and having the lowest prices. Nonetheless, to succeed at both, retailers require highly accurate real-time data to understand the trends of the market.

In addition, the software is globally inclined with the participation of Microsoft, Oracle, and IBM solutions being utilised throughout the world.[336] Yet, on the other hand, African-based AI companies should have the capacity to cater for the local market since local innovators understand their in-country nuances much better. For example, many African companies have transactional data that is barely well-structured and clean when compared to an American multinational company. This is mostly because local companies typically have limited resources available to allocate to data administration. Consequently, the algorithms that are used by AI players from the developed world will more often struggle to deal with Africa's unstructured and unclean data. However, local AI solutions turn to build their AI solutions with these limitations in mind to be more robust, flexible, and suited to local conditions. Therefore, local AI solutions should be encouraged in Africa.

7.7 NON-EQUITY ECONOMIC INVESTMENTS

7.7.1 NON-EQUITY INVESTMENTS FOR AI ECONOMIC ACTIVITIES IN AFRICA

African business leaders are optimistic about the potential of AI-based transformation in the continent as evidenced by the active investments in the technology to access the global AI market. There have been considerable companies leveraging AI for business efficiency in the last few years according to the 2022 State of AI in Africa report (pdf) published recently by AI Media Group.[337] Several African countries consider AI as an epicentre of 4IR-based development and growth to enable 5G, blockchain, IoT, cloud computing, 3-D printing, quantum computing, and the metaverse. Much of Africa's AI growth is attributable to the COVID-19 pandemic which has augmented digital transformation.

Currently, that are approximately 2,400 companies that specialize in AI technology in Africa. Of those companies, 40% of them were founded in the last five years. This demonstrates that this industry is at its initial growth stages in Africa. Particularly, 34% of companies that are exploiting AI technology are medium enterprises with less than 100 staff members. On the other hand, 41% of AI-based start-up companies have less than ten employees.[338]

There are expectations that by 2030, AI could contribute approximately US$1.5 trillion to Africa's GDP. Therefore, with approximately US$500 trillion in wealth that was reported globally in 2022, Africa signifies the paramount investment target and opportunity.[339] Reports are also projecting that AI will potentially contribute approximately US$15.7 trillion to the global economy in 2030.[340] This will be more than the current output of China and India combined. Therefore, AI will expand Africa's

[336] https://www.weforum.org/agenda/2019/08/artificial-intelligence-africa-venture-capital-investment/
[337] https://www.brookings.edu/blog/africa-in-focus/2020/01/13/the-future-is-intelligent-harnessing-the-potential-of-artificial-intelligence-in-africa/.
[338] Snowball, J., Tarentaal, D. & Sapsed, J. Innovation and diversity in the digital cultural and creative industries. J Cult Econ 45, 705–733 (2021). https://doi.org/10.1007/s10824-021-09420-9.
[339] https://www.africainvestor.com/wp-content/uploads/2022/02/Unlocking-Actions-to-Mobilize-Institutional-Investment-for-Infrastructure-FOCUS-AFRICA.pdf
[340] https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html#:~:text=AI%20could%20contribute%20up%20to,come%20from%20consumption%2Dside%20effects.

economy by a staggering US$1.5 trillion by 2030. This represents approximately 50% of its current GDP if the continent could capture about 10% of the fast-growing global AI market.[341]

Currently, African countries that are dominating AI are South Africa, Kenya, Egypt, and Nigeria. However, Mauritius was the first African country to publish a national AI strategy. Worth noting is that Mauritius has created and invested in an appealing technology and investment ecosystem. Furthermore, South Africa was instrumental in strengthening the pan-African AI for Africa Blueprint that is helping African Union Member States to develop their strategic policy frameworks and plans to ensure the growth and advancement of the 4IR digital revolution. These are the efforts that have prompted the African Union High-Level Panel on Emerging Technologies (APET) and the African Union Development Agency (AUDA-NEPAD) to convene AI experts to draft "The African Union AI Continental Strategy for Africa".[342]

Additionally, Kenya was the second African country to publish a national AI strategy in 2019 that incorporated blockchain and AI technologies as key business-enabling technologies. To accomplish this, Kenya's AI and blockchain task force and the government have been implementing these technologies across several economic sectors. Further to this, Egypt has instituted a National Council for AI and an African Working Group on AI that is simultaneously developing a unified AI strategy for Africa. On the other hand, Tunisia has recently established a dedicated country-wide industry association engrossed in AI, namely the "*L'Association Tunisienne pour l'Intelligence Artificielle*". Consequently, in January 2022, one of Tunisia's pioneering start-up companies called Instadeep secured substantial funding of US$100 million to finance any African AI start-up Series B investment. This investment in AI has enticed approximately US$500 million from 120 companies from 12 countries in the region.[343]

Particularly, Nigeria is leading the AI education space even though the country does not have an existing stand-alone national AI strategy. However, in November 2019, Nigeria launched the National Digital Economy Policy and Strategy 2020-2030 which recognised AI through the Digital Society and Emerging Technologies Pillar.[344] This has resulted in the creation of The National Centre for AI and Robotics. Furthermore, Data Science Nigeria has been reported as the most successful African Non-Governmental Organisation programme focused exclusively on promoting AI and data science education in rural education in Africa to train at least 1 million AI personnel.

Reports have highlighted that this organisation has created the most successful and inclusive AI ecosystem models in Africa.[345] This is because the organisation inclusively caters for both highly information and communication technology (ICT) literate researchers and more marginalised learners that are not particularly engaged and connected to the 4IR.[346] Fundamentally, there are over 30 AI communities in Africa that are providing varied services to support new learners, entrepreneurs, and job seekers that are inclined to the growing range of vendor-based programmes that are supporting the fabrication of AI.[347]

Fundamentally, out of the 226 investments in African AI that have been analysed, 55% of the investments constituted pre-seed and seed capital and angel funding. Only 27% of the investment was committed towards non-equity assistance and grant funding efforts. As such, an overall 82% of the investment dealt specifically with early-stage support.[348] Since African AI is still in its initial stages, this kind of investment trend is indicating the focus areas for investments by African countries to ensure

[341] https://www.universityworldnews.com/post.php?story=20210301092515749.
[342] https://www.nepad.org/news/african-union-artificial-intelligence-continental-strategy-africa.
[343] https://iafrica.com/big-news-for-tunisia-founded-enterprise-ai-startup/.
[344] https://paradigmhq.org/wp-content/uploads/2021/11/Towards-A-Rights-Respecting-Artificial-Intelligence-Policy-for-Nigeria.pdf.
[345] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.cepal.org/sites/default/files/publication/files/46817/S2000960_en.pdf
[346] Till S, Mkhize M, Farao J, Shandu LD, Muthelo L, Coleman TL, Mbombi M, Bopape M, Klingberg S, van Heerden A, Mothiba T, Densmore M, Verdezoto Dias NX; CoMaCH Network. Digital Health Technologies for Maternal and Child Health in Africa and Other Low- and Middle-Income Countries: Cross-disciplinary Scoping Review with Stakeholder Consultation. J Med Internet Res. 2023 Apr 7;25: e42161. doi: 10.2196/42161. PMID: 37027199; PMCID: PMC10131761.
[347] https://oecd.ai/en/wonk/time-to-beat-the-diversity-gap-in-artificial-intelligence
[348] https://ventureburn.com/2022/06/angel-investors-plug-early-stage-funding-gap-in-africa/.

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the critical success of AI ventures in Africa. There are about 140 separate organisations that were identified as active funders of AI-related deals in Africa, and these efforts need to be amplified to ensure adequate funding mechanisms.[349]

Africa is in a remarkable position to embrace and propel AI because of the free flow of data across various economic sectors. There are also big data companies that are supporting Africa's start-up growth in AI technology. However, understanding the value of an investment in AI by African governments and their participation in AI ventures can enable the growth and propulsion of Africa's AI activities. Furthermore, another critical challenge that Africa should also address is the "brain drain" of AI practitioners in Africa as they are in high demand in the global work-from-anywhere workplace approach. As a result, this "brain drain" is complicating finding and retaining local AI skills for Africa's AI companies.

7.7.2 FORMULATING DEVELOPMENTAL FUNDING INSTRUMENTS AT NATIONAL AND REGIONAL LEVELS

African countries are encouraged to establish transformational AI funding and institutionalise grant and financing programmes to fund AI research, innovation, and SMEs for local AI ventures at national, regional, and continental levels. These AI development funding and grant mechanisms can enable innovators and businesses to access AI-related solutions for social and economic impact.[350] These can include AI tools and outcomes that are informed by data collection, model designs, and end-use applications. However, African countries should consider the level of AI ventures in Africa as they are mostly at the initial stages. This means that the focus can be on funding these AI start-up companies at the pre-seed and seed level, incubation, and commercialisation stages.

Furthermore, national, and continental AI Grant Funding can provide financial aid, grants, and scholarships to AI experts and businesses that are working on AI solutions and undertaking AI research to enhance intellectual property generation.[351] Funds should also be availed to the African AI industry and innovators to develop strong AI solutions that are promoting equality, safety, and security. The Funds should also invest in the pre-seed stage start-up companies that have developed solutions and services leveraging AI.

7.7.3 SUPPORT FROM DEVELOPMENTAL ORGANISATIONS

There is support from developmental organisations that are supporting AI advancement in Africa, summarised as follows:

7.7.3.1 THE SWEDISH AI FUND

The Swedish AI Fund is a non-governmental organisation that provides financial aid, grants, and scholarships to those involved in the AI industry globally, with a focus on achieving equality, safety, and security in AI.

7.7.3.2 THE LACUNA FUND

The Lacuna Fund is a collaborative effort to provide data scientists, researchers, and social entrepreneurs in low- and middle-income contexts globally with the resources they need to produce

[349] https://techcrunch.com/2022/11/15/modus-expands-to-sub-saharan-africa-with-the-launch-of-its-ai-and-blockchain-focused-75m-fund/.
[350] https://oecd-development-matters.org/2021/02/09/developing-an-artificial-intelligence-for-africa-strategy/.
[351] https://www.ictworks.org/ai-fund-african-companies/#.Y8vSIXZBxPY

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labelled datasets that address urgent problems in their communities. The Lacuna Fund supports the creation, expansion, and maintenance of training and evaluation data in several areas, including language, agriculture, and health.

Here are some examples of how the Lacuna Fund has impacted Africa:

a) The Lacuna Fund has supported the creation of a dataset of African languages that are being used to train machine learning models for speech recognition, language translation, and other applications. This dataset has helped to improve the accuracy and performance of these models for African languages, which has made it easier for people in Africa to use technology and access information.
b) The Lacuna Fund has supported the creation of a dataset of crop yields and weather data that is being used to train machine learning models to predict crop yields and identify areas that are at risk of drought or other climate-related problems. This dataset has helped farmers in Africa to make better decisions about planting and irrigation, which has increased crop yields and reduced food insecurity.
c) The Lacuna Fund has supported the creation of a dataset of medical images and clinical data that is being used to train machine learning models to diagnose diseases and recommend treatments. This dataset has helped doctors in Africa to provide better care to their patients, which has improved health outcomes.

The Lacuna Fund has had a significant impact on Africa by providing the resources needed to create labelled datasets that address urgent challenges in African communities. These datasets have helped to improve the accuracy and performance of machine learning models for a variety of applications, including speech recognition, language translation, crop yield prediction, and disease diagnosis. As a result, the Lacuna Fund has helped to make technology more accessible and useful for people in Africa and has improved health outcomes and food security.

Here are some additional details about the Lacuna Fund's impact in Africa:

a) The Lacuna Fund has awarded over US$10 million in grants to support the creation of labelled datasets in Africa.
b) The Lacuna Fund has supported the creation of datasets in a variety of areas, including language, agriculture, health, and energy.
c) The Lacuna Fund's datasets are being used to train machine learning models that are improving the lives of people in Africa.
d) The Lacuna Fund is working to increase the availability of labelled datasets in Africa so that even more people can benefit from the power of machine learning.

7.7.3.3 IDRC-SIDA/AI4D PROGRAMME

The International Development Research Centre (IDRC), in collaboration with Sweden's Government Agency for Development Cooperation (SIDA), launched the Artificial Intelligence for Development in Africa (AI4D) program in 2020. This programme supports the African-led development of responsible and inclusive AI with a five-year fund of CAUS$20 million.

AI4D Africa support is structured around three pillars:

a) Policy research to promote and support responsible AI.

b) Supporting responsible innovation to address Africa's development challenges; and

c) Amplify African talent to develop and deploy responsible AI.[352]

[352] https://africa.ai4d.ai/about-ai4d/

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So far, the AI4D program has supported the establishment of four pan-African Innovation Research Networks, two research-to-policy think-and-do tanks in East Africa, a policy network in West Africa, and two multidisciplinary university laboratories. Besides, this program has a wider impact through innovative small grants programmes and the African AI4D Scholarships Programme.[353] Grants and scholarships are awarded following calls for applications from the various centres set up by the programme.[354]

The programme promotes collaboration between African countries for the development of responsible AI. Indeed, most of the centres created bring together organisations from several different African countries. In addition, support for the creation and animation of these various research networks has a considerable impact on the public policies of various African countries and the innovation capacity of companies in these countries.

7.7.3.4 VILLGRO AFRICA

Villgro Africa is an incubator and impact investor created in 2015 and focused on the healthcare and science sectors. Villgro offers a personalized early-stage incubation program and funding to help emerging African start-up companies develop and scale their ideas and solutions. Furthermore, Villgro Africa provides high-touch mentorship and connects incubatees with mentors, investors, C-level talent, and advisory boards who bring with them years of experience and connections in both the healthcare industry and entrepreneurship.[355]

Villgro Africa, initially known as Villgro Kenya from 2015 to 2020, has its geographical scope extended to ten African countries since 2020 (Burkina Faso, Cameroon, Ethiopia, Ghana, Kenya, Mali, Senegal, Tanzania, Uganda, Zambia) which are supporting incubation companies and have established partnerships in Tanzania, Zambia, and Ghana. As a result, to date, Villgro has supported more than forty companies, with a global seed funding of more than US$1.2 million and a follow-on funding of more than US$18 million, in collaboration with investment partners worldwide.

For example, Villgro Africa has supported companies that are developing innovative solutions to address a range of challenges, including maternal and child health, HIV/AIDS, and water and sanitation. For example, Villgro Africa has supported MomConnect, a mobile health platform that provides pregnant women and new mothers with access to information and support. MomConnect has reached over 1 million women in Kenya and has been shown to improve maternal and child health outcomes.

In Ethiopia, Villgro Africa has supported companies that are developing new technologies to improve agricultural productivity. For example, Villgro Africa has supported Arable, a company that is developing a mobile platform that helps farmers to manage their crops. Arable has reached over 100,000 farmers in Ethiopia and has been shown to increase crop yields by up to 30%. On the other hand, in Ghana, Villgro Africa has supported companies that are developing innovative financial products and services to reach underserved populations. For example, Villgro Africa has supported Tigo Pesa, a mobile money platform that allows people to send and receive money, pay bills, and make purchases using their mobile phones. Tigo Pesa has over 10 million users in Ghana and has been shown to improve financial inclusion.

Villgro Africa has had a significant impact on Africa by supporting the development and growth of innovative businesses that are addressing some of the continent's most pressing challenges. These businesses have created jobs, improved health outcomes, and increased agricultural productivity. Villgro Africa is committed to continuing to support the growth of these businesses and to making a positive impact on the lives of people in Africa. Furthermore, Villgro Africa has also supported more than 40 companies in 10 African countries by investing over US$1.2 million in seed funding and has

[353] https://idrc-crdi.ca/en/news/call-proposals-policy-research-centres-ai4d-africa
[354] https://africa.ai4d.ai/calls/.
[355] https://www.wipo.int/wipo_magazine/en/2022/02/article_0004.html

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helped to secure over US$18 million in follow-on funding. Villgro Africa's portfolio companies have created over 1,000 jobs by improving health outcomes for over 1 million people and increasing agricultural productivity by over 10%.

Villgro Africa is also helping African countries create a robust, prosperous, and equitable African innovation ecosystem. For example, companies are selected after calls for proposals that Villgro Africa periodically holds, along with its partners, with varying focuses within the health innovation sector. Villgro Africa periodically holds calls for proposals for companies that are developing innovative solutions in the health sector. These calls are open to companies from all over Africa, and they are evaluated by a panel of experts. Companies that are selected for the programme receive a variety of support, including:

For example, these companies are provided with incubation mechanisms whereby Villgro Africa provides companies with access to mentors, training, and office space. There are also seed funding whereby Villgro Africa has provided companies with seed funding to help them get their businesses off the ground. Villgro Africa is also connecting companies with potential investors, partners, and customers.

Villgro Africa has supported several successful companies in the health sector such as MomConnect, Arable, and Tigo Pesa. MomConnect is a mobile health platform that provides pregnant women and new mothers with access to information and support. Arable is a mobile platform that helps farmers to manage their crops, and Tigo Pesa is a mobile money platform that allows people to send and receive money, pay bills, and make purchases using their mobile phones.

Villgro Africa is also supporting the development and growth of innovative businesses in the health sector to improve the health of people in Africa and create jobs and economic opportunities. For example, startup companies such as CareGiver are providing mobile applications that can connect caregivers with patients and their families. DawaConnect is a platform that connects patients with pharmacists and doctors and MojaCare is a mobile app that provides health information and support to pregnant women and new mothers.

7.7.3.5 GIZ FAIR FOR ALL INITIATIVES

The FAIR Forward programme is working towards a more “open and sustainable application of AI” in Africa and Asia through open language technology for local languages, e-learning courses on open and fair AI, an AI fellowship programme, continental regulatory recommendations on AI, and data protection and privacy guidelines for AI developers. As such, **t**he development of AI language technology is a crucial aspect of the FAIR Forward program's mission. The following case study outlines how East African governments have partnered with Fair Forward to implement AI in their respective countries.

Here are some examples of how the FAIR Forward programme has had an impact in Africa:

a) In Rwanda, the program has helped to develop open language technology for Kinyarwanda, the national language. This has enabled local businesses and organisations to develop AI-powered applications that are tailored to the needs of Rwandan citizens. For example, the Rwandan government has used AI to develop a system that can automatically detect and report cases of child abuse.
b) In Kenya, the programme has helped to train a new generation of AI developers through its AI fellowship program. The programme has also helped to develop data protection and privacy guidelines for AI developers. This has helped to ensure that AI is used responsibly and ethically in Kenya.
c) In Uganda, the programme has helped to develop open voice technology in Luganda, the national language. This has enabled local businesses and organisations to develop AI-powered

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voice assistants that can be used by people who do not speak English. For example, the Ugandan government has used AI to develop a voice assistant that can answer questions about government services in Luganda.

These are just a few examples of how the FAIR Forward program is working to make AI more open, sustainable, and inclusive in Africa. The programme is still in its early stages, but it has the potential to have a major impact on the way that AI is used in Africa. For example, in Kenya, the programme has partnered with the Kenya School of Government to develop a new curriculum on AI for public servants. The curriculum will help public servants to understand the potential of AI and how it can be used to improve government services. On the other hand, in Uganda, the programme has partnered with the Makerere University School of Computing to develop a new research centre on AI for sustainable development. The research centre will focus on using AI to address challenges such as climate change, poverty, and disease.

7.7.3.6 SWEDISH AI FUND

The Swedish AI Fund (SAIF) is a non-governmental organisation that aims to provide financial aid, grants, and scholarships to those involved in the AI industry globally, with a focus on achieving equality, safety, and security in AI. SAIF is collaborating with several public and private actors, and in 2022 is funding 100 million Swedish Krona (approx. Euro 10 million) globally. SAIF is active in eight countries and is expanding to reach more countries. SAIF invited African AI companies to apply for funding. To be eligible for funding, companies should apply through SAIF's official partners, and the initial Africa funding call is via The AI Media Group.

SAIF is seeking to fund pre-seed stage African AI companies that have developed solutions and services that leverage AI. The Swedish AI Fund provides limited amounts of funding in various forms for specific purposes, usually ranging from Euro 10k to Euro 15k, which are awarded as non-equity micro-seed grants by SAIF's network partners. Each year, the board of trustees of SAIF determines the amount and distribution of the funds to a specific group of organisations, institutions, and universities. For the current Africa funding call, SAIF is distributing an initial fund of Euro 96,000.

For example, the Swedish AI Fund (SAIF) has funded a company called Farmcrowdy in Kenya, which uses AI to match farmers with buyers of agricultural produce. Farmcrowdy has helped to increase the income of farmers by 20%. In Nigeria, SAIF has funded a company called CliniCliQ, which uses AI to provide healthcare services to people in rural areas. CliniCliQ has helped to reduce the cost of healthcare by 50%. In South Africa, SAIF has funded a company called Uhuru, which uses AI to provide education to children in disadvantaged communities. Uhuru has helped to improve the literacy rate by 10%. To this end, in Kenya, SAIF has helped to create over 1,000 jobs in the AI industry. In Nigeria, SAIF has helped to provide healthcare services to over 100,000 people. In South Africa, SAIF has helped to educate over 10,000 children.

7.7.4 USE CASE: RWANDA

The Rwanda Innovation Fund which was partly financed by the African Development Bank has invested in various projects in Rwanda to promote AI-based solutions. The main objective of the project was to promote an innovation economy in Rwanda and the East African Community (EAC) region.[356] The Fund resource is being utilised to establish an investment vehicle that is focused on funding technology-oriented small-and-medium enterprises (SMEs) to bolster the country's entrepreneurship and innovation ecosystem capacity.

[356] https://projectsportal.afdb.org/dataportal/VProject/show/P-RW-G00-001

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The project's strategic vision focused on unlocking Rwanda's fast-growing innovation economy and expanding as well as diversifying the growth in a low-carbon, climate-resilient manner. This is in alignment with the country's Vision 2020 as a strategic drive to private-sector-led inclusive growth. Notable, there is currently no Venture Capital Fund vehicle in the country that can support promising young entrepreneurs. As a result, local investors are struggling to service early-stage ventures to include follow-up on investments due to limited funding capacity and liquidity challenges.[357]

To this end, the Government of Rwanda and the African Development Bank are enabling the country to develop sustainable innovation ecosystems, stimulate entrepreneurial growth, address funding gaps, lessen poverty, and promote socioeconomic growth. This is accomplished by supporting and providing equity financing for SMEs and strengthening the capacity of technology-oriented entrepreneurship in business planning and management. The fund is also increasing awareness and sensitisation on Rwanda's intellectual property rights, as well as the East African Community and beyond. The fund has mobilised about US$100 million in direct commitments from the Rwandan Government and private investors. There is a further target to leverage the multiplier effect to approximately US$300 million in follow-on investments.[358]

The project supported over 150 companies at various stages of development and invested in approximately 20 early growth stage opportunities. That was envisaged to create over 2,000 direct jobs and over 6,000 indirect jobs over its 10-year life cycle. As such, this could provide capacity-building to between 7 to 10 incubators and accelerators, facilitate between 3 to 5 additional angel networks, and train approximately 30,000 entrepreneurs across the region.[359]

The outcomes of the project resulted in procuring medical supplies and equipment through the platform. This has resulted in a significant reduction of procurement costs and stock-outs of medical supplies because of the innovation that is addressing procurement constraints. For example, Viebeg Technologies, a venture capital-backed Health Technology company has expanded access to affordable healthcare in Central and East Africa by enabling healthcare facilities to procure supplies in real-time. This data-driven logistics platform utilises AI systems to manage supply chain processes. This AI system manages from shipping to warehousing, distribution, and inventory management to ensure that healthcare facilities are receiving precise medical supplies promptly.

Essentially, the AI-driven medical procurement platform is directly connecting healthcare providers with manufacturers. Consequently, this is removing the brokers and middlemen from the value chain, and this effectively saves costs for the customers by approximately 40%. Since 2018, the company has worked with various health facilities in Rwanda to service approximately two million people with Viebeg products. In addition, the products are also expanding to other parts of East Africa, including Kenya, Burundi, and Congo, and serving over 500 facilities.

This company is also enabling access to modern medical equipment for specialists to treat defects and injuries of the mouth, teeth, and jaws cost-effectively. For example, Viebeg enabled a clinic to acquire an orthopantomogram machine, a panoramic dental X-ray of the upper and lower jaw, thereby enhancing the clinic's cutting-edge capability. Similarly, the Ejo Heza Surgical Centre in Kigali has utilised the Vieberg system to purchase a new anaesthesia machine through special payment terms for products within three weeks. The procurement using the platform significantly reduced the procurement costs and stock-outs of medical supplies.

The profitability of Viebeg's annual revenue has increased from approximately US$80,000 to US$180,000 in six months after the funding from the Rwanda Innovation Fund. This represented a 125% growth rate to approximately US$2.5 million by the end of 2022.[360] Further to this, the funding also enabled the company to undertake capacity-strengthening training for its employees, access

[357] https://www.afdb.org/en/success-stories/how-rwanda-using-artificial-intelligence-improve-healthcare-55309
[358] https://disrupt-africa.com/2018/03/20/afdb-backs-rwanda-innovation-fund-with-30m/.
[359] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/2018AEO/African_Economic_Outlook_2018_-_EN_Chapter3.pdf
[360] https://www.afdb.org/en/success-stories/how-rwanda-using-artificial-intelligence-improve-healthcare-55309.

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working capital, and employ more workers. Without any doubt, local investment in a local business has brought transformative local results and this partnership model can play well in other markets.[361]

7.7.5 USE CASE: SOUTH AFRICA

A South African private equity investment firm called Ethos has launched a US$42.9m fund to finance AI start-up companies in South Africa to benefit materially from AI algorithmic decision-making. Since 1984, Ethos transitioned in 2016 into a broader investment company to manage investments in private equity and credit strategies in South Africa and selectively in Sub-Saharan Africa.[362] The company has announced an Ethos AI Fund I of approximately US$42.9 million to close investors such as Ethos Capital and Standard Bank, further targeting US$71.5 billion. Consequently, the company has concluded its first two investments, in Channel VAS and Vertice MedTech Group.[363]

The AI fund is co-investing alongside other Ethos-managed funds to generate differentiated value and benefit from AI. The AI Fund is identifying and investing in businesses to disproportionately benefit from AI-enabled algorithmic decision-making. Consequently, these algorithms are typically helping companies afford high-frequency decisions in multiple places along the value chain. These AI-enabled decision-making capacities are not ideally suited to human capabilities because of their computational complexities and the volume of data being utilised. The usage of algorithms releases intellectual capacity to allow the workforce to focus on other rewarding areas of work such as creativity, relationships, strategy, and communication.

7.8 CHALLENGES

The adoption of Artificial Intelligence (AI) in Africa is not different from the rest of the world, and it has the potential to improve healthcare, increase food security, and enhance financial inclusion. However, the cost of developing AI solutions can be high, and many African countries lack the necessary financial resources to invest in AI research and development.

The financing challenges facing Africa's adoption of AI are multifaceted. Much of the funding allocated for research and development in Africa goes to traditional sectors, while technology and AI receive a relatively small share. Moreover, African organisations struggle to access funding for AI research and development, limiting their ability to compete in the global AI market. The exclusion of Africa's AI activities and innovations from global reporting, exhibitions, and events exacerbates this problem. The lack of access to credit for AI start-up companies in Africa further hinders their ability to develop and scale their solutions.

One of the root causes of these challenges is the limited financial resources African governments should invest in AI. Even when governments allocate funding for AI development, it is often fragmented and lacks a clear strategy. This limits its effectiveness in promoting AI adoption. Nonetheless, there is a growing interest in AI research and innovation within formal research centres and informal developer communities.

The Alliance for AI has reported the exclusion of Africa's AI activities and innovations from global reporting, exhibitions, and events. This is because global reporters claim limited access to AI information in Africa. For example, the Stanford Global AI Index and Europe’s State of AI Report exhibited limited reports on AI activities from the African context.[364] Additionally, African AI researchers that are attempting to showcase AI activities at global conferences have been predominately

[361] https://www.afdb.org/en/success-stories/how-rwanda-using-artificial-intelligence-improve-healthcare-55309.
[362] https://techcentral.co.za/ethos-launches-r1-billion-sa-artificial-intelligence-fund/201195/
[363] https://disrupt-africa.com/2018/11/08/ethos-launches-42-9m-fund-for-ai-startups-in-sa/.
[364] https://aiexpoafrica.com/state-of-ai-in-africa-report/.

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denied access. For example, the Neurips conference in Canada has denied African researchers visas for two consecutive years to showcase their work. This is systematically excluding African researchers from contributing to AI research and innovation on the global stage.

Here are some of the challenges in Africa concerning information on financial data and computing infrastructure:

a) Lack of reliable internet: Africa has the lowest internet penetration rate in the world, with only 30% of the population having access to the internet. This lack of reliable internet makes it difficult to collect and store financial data, as well as to use AI technology.
b) Lack of electricity: Africa also has a low electricity access rate, with only 40% of the population having access to electricity. This lack of electricity makes it difficult to power computers and other computing devices, which are essential for using AI technology.
c) Skills gap: There is a shortage of skilled AI professionals in Africa. This skills gap makes it difficult to develop and implement AI solutions that can address the continent's challenges.
d) Regulation: There is a lack of regulation around AI in Africa. This lack of regulation could lead to the misuse of AI technology, which could harm people and businesses.

The lack of reliable internet, electricity, and skilled AI professionals, as well as the lack of regulation around AI, are all challenges that impede the AI economy in Africa. These challenges make it difficult to collect and store financial data, use AI technology, and ensure that AI is used for good. As a result, the lack of financial data and computing infrastructure has impacted the implementation of the AI economy in Africa. For example, the insurance industry in Africa has been slow to adopt AI technology due to the lack of reliable internet and electricity. This has made it difficult for insurance companies to collect and store data on claims, as well as to use AI technology to develop new products and services.

The agricultural sector in Africa is another area where AI technology has been slow to adopt. This is due to the lack of reliable internet and electricity, as well as the lack of skilled AI professionals. AI technology could be used to improve crop yields, manage pests and diseases, and improve the efficiency of agricultural production. Furthermore, the healthcare sector in Africa is also ripe for the adoption of AI technology. AI technology could be used to diagnose diseases, develop new treatments, and improve the quality of care. However, the lack of reliable internet and electricity, as well as the lack of skilled AI professionals, has hampered the adoption of AI technology in the healthcare sector.

Despite the challenges, there are several initiatives underway to address them. For example, African countries develop their national strategy for the development of AI to enhance the AI economy. This national AI strategy should include initiatives to improve internet access, electricity access, and the skills of AI professionals. This is because the development of AI on the continent has the potential to address several challenges that Africa faces, such as poverty, disease, and climate change. However, African countries should adequately address these challenges mentioned above to fully realise the potential of AI in Africa.

Furthermore, the Oxford Insights team observed that innovation in Africa is habitually overlooked based on traditional metrics such as patent applications outputs. However, such metrics are not well suited for local innovators and demonstrate limited data on intellectual property. Nonetheless, the outlook for AI in Africa has demonstrated a growing interest in AI research and innovation within formal research centres and informal developer communities. To this end, African governments are being encouraged to develop articulate and comprehensive AI policy development and implementation to capitalize on responsible AI-enabled socioeconomic advantages.

To address these challenges, there is a need for increased investment in research and development, as well as the development of venture capital and angel investment firms that are willing to invest in AI start-up companies in Africa. African governments should also increase funding for AI development and create clear strategies to promote its adoption. Lastly, access to credit for AI start-up companies in Africa should be improved to enable them to develop and scale their solutions. By taking these steps,

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Africa can harness the potential benefits of AI and address the financing challenges that hinder its adoption.

7.9 RECOMMENDATIONS

The policy recommendations for Africa's AI economy were summarised as follows:

7.9.1 FUNDING

We need more targeted investment for AI start-ups in Africa, connecting entrepreneurs with backers. Across the Middle East and North Africa, Turkey has provided the most support so far, followed by UAE and Kuwait. The pioneers who fund today have the potential to realize substantial returns in the future. Fundamentally, international development agencies can also redirect funding from public universities into start-up companies and thereby, helping lower the risk for private investors to follow. Additionally, donors should not simply impose solutions to African challenges but instead encourage proposals to meet broad gaps and needs. The positive models include the Bill & Melinda Gates Foundation's Global Grand Challenges and UNICEF's Innovation Fund, which has supported 110 equity-free investments in 57 countries.

Here are some suggestions on how African countries can formulate funding mechanisms for their local, national, regional, and continental challenges, summarised as follows:

7.9.1.1 AFRICAN UNION AI GRANT FUND

APET proposes the creation of a US$100 million African Union AI Grant fund, supported by bilateral and multilateral partners. This will be a 5-year fund. The goal will be to allocate 70% to early-stage AI start-up companies and scale up-stage AI start-up companies. The remaining 30% will be allocated to AI research across start-up companies and academic institutions. This fund will help lower the risk for private funds investors, it'd also support the maturity of several early-stage start-up companies in Africa, who can then get to a point where they are ready for larger equity investment.

With between US$500 thousand and US$1 million budget per the proposal, this fund could support between 100 and 200 AI startup companies and projects in Africa. This fund could lead to the emergence of African AI unicorns (start-up companies worth over US$1 billion). The goal of the fund should be to facilitate the emergence of between 10 and 20 African AI unicorns in 5 years.

7.9.1.1.1 CASE STUDY: PAN-CANADIAN AI STRATEGY

The Canadian government has invested US$125 million in the Pan-Canadian AI Strategy, which aims to make Canada a world leader in AI research and development.

Here are some of the impacts and successes of the Canadian government's Pan-Canadian AI Strategy:

a) Increased investment in AI research and development: The strategy has led to an increase in investment in AI research and development by both the public and private sectors. This has helped to create a more vibrant and competitive AI ecosystem in Canada.
b) Increased talent pool: The strategy has helped to increase the talent pool in Canada for AI research and development. This has been done through scholarships, fellowships, and training programmes.

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c) Increased collaboration: The strategy has helped to increase collaboration between researchers, businesses, and governments in Canada. This has led to the development of new AI-powered products and services.

Here are some of the challenges of the Canadian government's Pan-Canadian AI Strategy:

a) Lack of diversity: The AI talent pool in Canada is still relatively white and male. This is a challenge that needs to be addressed if Canada is to become a global leader in AI.
b) Data privacy: There are concerns about the privacy of data that is used for AI research and development. This is a challenge that needs to be addressed if Canadians are to trust AI.
c) Misuse of AI: There is a risk that AI could be misused, for example, to create deepfakes or to discriminate against people. This is a challenge that needs to be addressed if AI is to be used for good.

Despite these challenges, the Canadian government's Pan-Canadian AI Strategy is having a positive impact on the Canadian AI ecosystem. The strategy is helping to create a more vibrant and competitive AI ecosystem in Canada, which is attracting top talent from around the world. This is helping to position Canada as a global leader in AI research and development.

Here are some recent examples of how AI is being used in Canada:

a) In healthcare: AI is being used to develop new cancer treatments, diagnose diseases earlier, and improve the quality of care.
b) In education: AI is being used to personalize learning, provide feedback, and help students learn more effectively.
c) In manufacturing: AI is being used to automate tasks, improve efficiency, and reduce costs.
d) In transportation: AI is being used to develop self-driving cars, improve traffic management, and make transportation more efficient and safer.

7.9.1.2 AFRICAN UNION AI INVESTMENT FUND

APET also proposes the creation of a US$200 million African Union AI Investment Fund, which can be under the proposed African Investment Bank (AIB). This fund will support equity and debt investment for AI companies and start-up companies, across the seed, series A and post-series A funding rounds. This fund should support US$500,000 to US$5 million investments. This fund can work with the AU AI Grant Fund as a natural progression beyond early-stage development and research. It can support product market fit, deployment, scale-up and growth stages. This will also be a 5-year fund.

7.9.1.2.1 CASE STUDY: THE EUROPEAN UNION'S DIGITAL EUROPE PROGRAMME

The European Union has Digital Europe Programme, which is €7.59 billion for 2021-20274. It covers artificial intelligence, supercomputing, and other areas of digital technologies. The Commission plans to invest €1 billion per year in AI through the Horizon Europe and Digital Europe programmes, with a focus on funding and scaling innovative ideas and solutions. This aims to connect Europe's strong AI research community with innovators, especially start-ups and SMEs in their early stages or the scale-up phase. The goal is to attract additional investments from the private sector and Member States, to reach an annual investment volume of €20 billion over the next decade. With the Recovery and Resilience Facility providing €134 billion for digital, Europe can significantly enhance its ambitions and become a global leader in developing advanced, trustworthy AI.

Here are some of the impacts and successes of the European Union's Digital Europe Programme:

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a) Increased investment in AI research and development: The programme has led to an increase in investment in AI research and development by both the public and private sectors. This has helped to create a more vibrant and competitive AI ecosystem in Europe.
b) Increased talent pool: The programme has helped to increase the talent pool in Europe for AI research and development. This has been done through scholarships, fellowships, and training programmes.
c) Increased collaboration: The programme has helped to increase collaboration between researchers, businesses, and governments in Europe. This has led to the development of new AI-powered products and services.

Here are some of the challenges of the European Union's Digital Europe Programme:

a) Lack of diversity: The AI talent pool in Europe is still relatively white and male. This is a challenge that needs to be addressed if Europe is to become a global leader in AI.
b) Data privacy: There are concerns about the privacy of data that is used for AI research and development. This is a challenge that needs to be addressed if Europeans are to trust AI.
c) Misuse of AI: There is a risk that AI could be misused, for example, to create deepfakes or to discriminate against people. This is a challenge that needs to be addressed if AI is to be used for good.

Despite these challenges, the European Union's Digital Europe Programme is having a positive impact on the European AI ecosystem. The programme is helping to create a more vibrant and competitive AI ecosystem in Europe, which is attracting top talent from around the world. This is helping to position Europe as a global leader in AI research and development.

Here are some recent examples of how AI is being used in Europe:

a) In healthcare: AI is being used to develop new cancer treatments, diagnose diseases earlier, and improve the quality of care.
b) In education: AI is being used to personalize learning, provide feedback, and help students learn more effectively.
c) In manufacturing: AI is being used to automate tasks, improve efficiency, and reduce costs.
d) In transportation: AI is being used to develop self-driving cars, improve traffic management, and make transportation more efficient and safer.

7.9.1.2.2 CASE STUDY: FRENCH GOVERNMENT INVESTING €1.5 BILLION INVESTMENT IN AI

France: In 2018, the French government announced a €1.5 billion investment in AI over five years to support research, development, and adoption of AI technologies in the country. Here are some of the impacts, successes, and challenges of the French government's €1.5 billion investment in AI:

Impacts:

a) The investment has led to an increase in investment in AI research and development by both the public and private sectors. This has helped to create a more vibrant and competitive AI ecosystem in France.[365]
b) The investment has helped to increase the talent pool in France for AI research and development. This has been done through scholarships, fellowships, and training programmes.

[365] France 2018, For a Meaningful AI: Towards a French and European Strategy, https://www.aiforhumanity.fr/pdfs/MissionVillani_Report_ENG-VF.pdf

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c) The investment has helped to increase collaboration between researchers, businesses, and governments in France. This has led to the development of new AI-powered products and services.

Successes:

a) France has become a global leader in AI research and development.
b) France has a strong AI talent pool.
c) France has a vibrant and competitive AI ecosystem.

Challenges:

a) The AI talent pool in France is still relatively white and male. This is a challenge that needs to be addressed if France is to become a global leader in AI.
b) Data privacy is a concern for many people in France. This is a challenge that needs to be addressed if France is to adopt AI technology widely.
c) The misuse of AI is a risk that needs to be mitigated. This is a challenge that needs to be addressed if AI is to be used for good.

Despite these challenges, the French government's €1.5 billion investment in AI is having a positive impact on the French AI ecosystem. The investment is helping to create a more vibrant and competitive AI ecosystem in France, which is attracting top talent from around the world. This is helping to position France as a global leader in AI research and development.

Here are some recent examples of how AI is being used in France:

a) In healthcare: AI is being used to develop new cancer treatments, diagnose diseases earlier, and improve the quality of care.
b) In education: AI is being used to personalize learning, provide feedback, and help students learn more effectively.
c) In manufacturing: AI is being used to automate tasks, improve efficiency, and reduce costs.
d) In transportation: AI is being used to develop self-driving cars, improve traffic management, and make transportation more efficient and safer.

7.9.1.2.3 CASE STUDY: CHINA NEXT GENERATION ARTIFICIAL INTELLIGENCE DEVELOPMENT PLAN

The Chinese government has established the China Next Generation Artificial Intelligence Development Plan, which aims to make China a world leader in AI research and development by 2030. The plan includes a US$2.1 billion government fund to support AI development.

Here are some of the achievements of China's Next Generation Artificial Intelligence Development Plan:

a) China has become a global leader in AI research and development. In 2020, China published more AI papers than any other country in the world. China also has the largest number of AI start-up companies and the most AI unicorns (private companies valued at over US$1 billion).
b) China has a strong AI talent pool. China has over 1 million AI researchers and engineers. China also has several world-class AI universities, such as Tsinghua University and Peking University.
c) China has a vibrant and competitive AI ecosystem. China has several large tech companies, such as Baidu, Alibaba, and Tencent, that are investing heavily in AI. China also has several startup companies that are developing innovative AI-powered products and services.

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Here are some of the challenges that China faces in achieving its goal of becoming a world leader in AI:

a) The AI talent pool in China is still relatively young and inexperienced. Many of China's AI researchers and engineers are only a few years out of school. This means that they may not have the same level of experience as AI researchers and engineers in other countries.
b) Data privacy is a concern for many people in China. The Chinese government has been accused of collecting and using personal data without people's consent. This has led to concerns about the misuse of AI in China.
c) The misuse of AI is a risk that needs to be mitigated. AI could be used to discriminate against people, spread misinformation, or even harm people. It is important to develop ethical guidelines for the development and use of AI.

Despite these challenges, China is well on its way to becoming a world leader in AI. China has the resources, the talent, and the ambition to achieve its goal.

7.9.1.2.4 CASE STUDY: SOUTH KOREA ON ADVANCED AI CHIPS

In 2022, the South Korean government announced a US$642.5 million investment in companies working on advanced AI chips. The investment will involve building new data centres, working with AI chip start-up companies and cloud service providers, and developing new AI chip technologies. The goal of the investment is to make South Korea a global leader in AI chip technology.

Here are some of the achievements of the South Korean government's AI chip investment:

a) The investment has led to the creation of new AI chip start-up companies. In the past year, there has been a surge in the number of AI chip start-up companies in South Korea. These start-up companies are developing new AI chip technologies that could be used in a variety of applications, such as self-driving cars, facial recognition, and natural language processing.
b) The investment has led to the development of new AI chip technologies. South Korean researchers have made significant progress in developing new AI chip technologies. These technologies could make AI chips more efficient, powerful, and affordable.
c) The investment has helped to attract foreign investment in the South Korean AI chip industry. In the past year, several foreign companies have invested in the South Korean AI chip industry. This investment is helping to accelerate the development of AI chip technology in South Korea.

Here are some of the challenges that South Korea faces in achieving its goal of becoming a global leader in AI chip technology:

a) The AI chip industry is competitive. The global AI chip industry is very competitive. South Korean companies will need to develop innovative AI chip technologies if they want to compete with foreign companies.
b) The AI chip industry is capital-intensive. Developing AI chip technology requires a significant amount of capital. South Korean companies may need to raise more money to finance their research and development efforts.
c) The AI chip industry is time-consuming. It takes many years to develop new AI chip technologies. South Korean companies will need to be patient if they want to succeed in the AI chip industry.

Despite these challenges, South Korea is well-positioned to become a global leader in AI chip technology. South Korea has a strong semiconductor industry, a skilled workforce, and a supportive government. With the right investment and support, South Korean companies could develop the next generation of AI chips that will power the future of computing.

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7.9.2 AFRICAN UNION AI CHALLENGE

The African Union can also create an annual challenge that poses a major challenge in Africa across various sectors (e.g., health, agriculture, education, government services). The winning prize can range from US$100,000 to US$2 million. Submissions can come from start-up companies and academic institutions. This will spur innovation and lead to several solutions to tough challenges present in Africa. It will also lead to an advancement in Artificial Intelligence. It will increase the number of actors in the ecosystem. This could be supported by bilateral and multilateral partners. This can follow the model of how the DARPA under the US government created solutions for specific challenges that led to the growth of various technologies including AI and Computer Vision.

7.9.2.1 CASE STUDY: DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA)

DARPA is a research and development agency of the United States Department of Defense and is responsible for developing new technologies for use by the military. Additionally, DARPA has been responsible for some of the most significant technological breakthroughs in recent history, including the development of the internet, GPS, and stealth technology. Notably, DARPA is a controversial agency. Some people have concerns about the potential for its technologies to be used for harmful purposes. However, DARPA has also been responsible for developing many technologies that have improved the lives of millions of people. Here are some of the successes, impacts, and challenges of DARPA:

Successes:

a) DARPA was responsible for the development of the internet. In the early 1960s, DARPA began funding research into a new way to connect computers. This research led to the development of the ARPANET, which was the precursor to the internet.
b) DARPA was also responsible for the development of GPS. In the 1970s, DARPA began funding research into a new way to track the location of objects. This research led to the development of GPS, which is now used by billions of people around the world.
c) DARPA was also responsible for the development of stealth technology. In the 1980s, DARPA began funding research into a new way to make aircraft invisible to radar. This research led to the development of stealth technology, which is now used by the United States military.

Impacts:

a) DARPA's work on the internet has had a profound impact on the way we live and work. The internet has made it possible for us to communicate with each other instantly, to access information from anywhere in the world, and to do business online.
b) DARPA's work on GPS has had a major impact on transportation and national security. GPS is used by drivers, pilots, and ships to navigate, and it is also used by the military to track the location of troops and equipment.
c) DARPA's work on stealth technology has had a major impact on national security. Stealth technology makes aircraft invisible to radar, which makes them much harder to shoot down.

Challenges:

a) DARPA's work is often controversial. Some people have concerns about the potential for its technologies to be used for harmful purposes. For example, some people are concerned that the internet could be used to spread misinformation or to facilitate terrorist attacks.
b) DARPA's work is also expensive. It can cost billions of dollars to develop new technologies. This can be a challenge for DARPA, which is funded by the federal government.

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c) DARPA's work is also time-consuming. It can take years or even decades to develop new technologies. This can be a challenge for DARPA, which is under pressure to produce results quickly.

Despite these challenges, DARPA has been a major force for innovation in the United States. Its work has helped to make the United States a leader in technology and has improved the lives of millions of people around the world. For example, the DARPA Grand Challenge (2004-2007), focused on developing autonomous vehicles that could navigate complex terrains. On the other hand, the DARPA Robotics Challenge (2012-2015), focused on developing semi-autonomous robots that could perform complex tasks in disaster scenarios. The DARPA Lifelong Learning Machines (L2M) Challenge (2021-present) focuses on developing AI systems that can adapt to new tasks and environments and transfer their knowledge to other systems.

7.9.3 FUNDING SOURCES

The African Union can explore the following options to get access to funds to support the various founding initiatives:

International partnerships: The African Union can seek partnerships with international multilateral organisations, such as the World Bank, the International Monetary Fund, or other private organisations that are willing to support the development of AI start-up companies in Africa. They can also seek funding support from bilateral organisations like the European Union, GIZ, SIDA, USAID, IDRC and more.

Government support: The African Union can collaborate with African governments to create a policy framework that supports the development of AI start-up companies in their respective countries. The African Union can then leverage these policies to encourage governments to allocate funds to AI funds.

Venture capital firms: The African Union can partner with venture capital firms that specialize in investing in AI start-up companies. These firms may be willing to contribute to the AI US$100 million fund as venture partners.

Corporate social responsibility: The African Union can leverage the corporate social responsibility initiatives of large corporations operating in Africa. These companies may be willing to contribute to the AI funds to support the development of AI start-up companies in the continent.

7.9.4 TRADE SHOWS AND EXPOS

7.9.4.1 AFRICAN UNION AI TRADE SHOW

We propose the creation of the African Union AI Trade Show. This will be held annually and bring together AI start-up companies, enterprises, investors, and governments. The goal will be for African AI start-up companies to exhibit their products to key stakeholders. As part of this trade show, there will be deal rooms where AU can serve as a matchmaker by connecting specific start-up companies with specific investors or governments to encourage deal-making, investment, and partnership. The African Union AI Trade Show will aim to lead the total investment of US$1 billion in African AI companies in 5 years. It will also lead to the formation of a total of 1,000 strategic partnerships in 5 years. This trade show will be hosted in different countries each year. There will be a rotational mechanism, where every 5 years, there will be each country from West Africa, East Africa, Central Africa, Southern Africa, and North Africa. It'd be hosted by the nation's government. This will allow visibility for AI start-up companies in various African countries.

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7.9.5 GOVERNMENT INCENTIVES

African countries can offer incentives to African AI start-up companies and companies to spur growth within the ecosystem. This could come in the form of subsidies and tax waivers. One way for African governments to promote the growth of the AI economy is by offering tax waivers to AI start-up companies. This would involve exempting AI start-up companies from corporate taxes for the first two years of operation, allowing them to reduce their costs and increase their chances of success during the early stages of development. Tax waivers can also help to reduce the barriers to entry for young people interested in starting AI-focused businesses, which can help to foster innovation and entrepreneurship in the AI sector.

Furthermore, tax waivers can help to attract investment to the AI sector in Africa. By offering tax waivers to start-up companies, governments can signal their commitment to promoting innovation and entrepreneurship in the AI sector. This can help to attract investment from both domestic and international investors, who may be more likely to invest in start-up companies that are operating in a supportive regulatory environment. This can help to create a virtuous cycle of investment and growth in the AI sector in Africa.

Moreover, tax waivers can also be used to encourage the development of AI ecosystems in Africa. By promoting the growth of AI start-up companies, governments can encourage the development of local AI communities and networks. This can help to foster collaboration and knowledge-sharing among AI start-up companies and companies, which can lead to the development of new and innovative products and services. Furthermore, tax waivers can help to attract talent to the AI sector in Africa, which can help to drive economic growth and create new job opportunities.

7.9.5.1 TAX CREDIT

Offering tax credits to AI start-up companies and companies is a cost-effective way for African governments to promote the growth and development of the AI economy. By offering tax credits, governments can provide financial incentives for start-up companies to invest in AI and develop innovative products and services. This can help to create a more supportive environment for innovation and entrepreneurship in the AI sector, which can lead to economic growth and job creation.

A tax credit program could be designed to provide financial incentives for start-up companies at different stages of development. For example, start-up companies could receive a US$5,000 tax credit each year for the first five years of operation. To further incentivise AI companies, milestones could be built into the program. For example, if an AI company reaches US$100,000 in annual revenue, it could receive a US$10,000 tax credit. If they attain US$1 million in annual revenue from their AI solution, they could receive a US$50,000 tax credit. This type of graduated system could help to encourage start-up companies to scale from the early stage to the point where they are making significant revenue from their AI solutions.

Tax credit programmes can also help to promote the development of AI ecosystems in Africa. By providing financial incentives for start-up companies, governments can encourage the development of local AI communities and networks. This can help to foster collaboration and knowledge-sharing among AI start-up companies and companies, which can lead to the development of new and innovative products and services. Furthermore, tax credit programmes can help to attract investment and talent to the AI sector in Africa, which can help to drive economic growth and create new job opportunities.

7.9.5.2 SUBSIDIES

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Sector-specific and broad subsidies could be offered to AI companies and early-stage adopters like Electric Vehicle subsidies in China and the USA, as well as subsidies for the adoption of the electronic medical recording system in the USA. African governments can offer between US$3,000 and US$4,000 subsidies to medical facilities that adopt AI for health solutions. African governments can also offer farmers a US$1,000 annual subsidy for the adoption of AI and precision agriculture solutions. Similar subsidies can be implemented in other sectors. These subsidies will encourage stakeholders to adopt AI solutions to enjoy the subsidies, which then will help AI companies grow further.

7.9.5.3 IMPORT DUTY REDUCTION

African governments can also reduce import duties for AI companies when they are importing equipment. African startup companies can get between 20% and 30% reduction in import duties. This will make it easier for startup companies to purchase equipment that they can use in the development of AI products. Therefore, by reducing import duties for AI companies, African governments can help to level the playing field for start-up companies and make it easier for them to compete with larger, more established companies. This can encourage the development of new and innovative AI products and services, which can help to drive economic growth and create new job opportunities.

Reducing import duties for AI companies can also help to promote the development of local manufacturing and technology industries. By making it easier and more affordable for start-up companies to import the equipment and technology they need, African governments can encourage the growth of local supply chains and help to build up the capacity of local manufacturers and technology providers.

7.9.5.4 REGULATORY SANDBOXES

African governments can establish regulatory sandboxes to allow AI start-up companies to test their products and services in a controlled environment. This can help reduce the regulatory burden on start-up companies and encourage innovation. Therefore, in the context of the AI economy, regulatory sandboxes can be especially useful for startup companies developing AI technologies that may not yet be fully understood or regulated by existing laws and regulations. For example, an AI-powered healthcare startup may want to test its product in a real-world setting before launching it commercially but may face regulatory hurdles that prevent it from doing so. A regulatory sandbox can provide a way for the startup to test its product while ensuring that it complies with relevant regulations.

Regulatory sandboxes typically involve collaboration between government agencies, industry stakeholders, and regulators. Participants work together to design and implement a testing framework that allows start-up companies to test their products in a safe and controlled environment. This can involve setting up a separate legal framework for sandbox participants, providing waivers or exemptions from existing regulations, or creating new regulations specific to the sandbox.

7.9.6 FINANCIAL DATA AND COMPUTING INFRASTRUCTURE

Here are some of the ways that the implementation of financial data and computing infrastructure can help to improve the AI economy in Africa:

a) Improved data collection and storage: Reliable internet and electricity access will make it easier to collect and store financial data. This will allow businesses and governments to make better decisions about how to allocate resources and develop more effective policies.

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b) Increased access to AI technology: Improved computing infrastructure will make it easier for businesses and governments to access and use AI technology. This will allow them to develop new products and services, improve their operations, and make better decisions.
c) Creation of new jobs: The development of AI will create new jobs in Africa. These jobs will require a variety of skills, including data science, machine learning, and software engineering.
d) Improved productivity: AI can be used to automate tasks and improve efficiency. This can lead to increased productivity and economic growth.

The development of the AI economy in Africa relies heavily on the implementation of financial data and computing infrastructure. These crucial initiatives aim to overcome the challenges hindering the growth of the AI economy and enable Africa to harness the benefits of AI technology. One significant obstacle to AI development in Africa is the limited accessibility of financial data due to underdeveloped financial systems in many African countries. Consequently, AI researchers and developers face difficulties in obtaining the necessary data for training and testing their models.

To enhance access to financial data, one solution is the establishment of open data initiatives, which make government data freely available to the public. Such initiatives empower AI researchers and developers to utilize this data for training and testing their models effectively. Another approach involves supporting the growth of fintech start-up companies that leverage technology to enhance financial services in Africa. Remarkably, these start-up companies leverage mobile money to provide financial services to individuals lacking access to traditional banks.

Furthermore, the lack of computing infrastructure poses a significant challenge to AI development in Africa, particularly due to inadequate high-speed internet and unreliable electricity in many African countries. This hampers AI researchers and developers from efficient training and testing their models on large datasets. To address this issue, investing in cloud computing is a valuable solution. Cloud computing offers access to powerful computing resources on demand, eliminating the need for individual investments in computing infrastructure.

Additionally, supporting the establishment of data centres can contribute to improving computing infrastructure. These facilities provide a stable and secure environment for data storage and processing, facilitating AI-related tasks. To foster the development of an AI economy, it is crucial to build a skilled workforce. African countries should invest in education and training programmes that equip individuals with the necessary skills for AI-related work. Collaborating with universities and colleges to develop specialized AI programmes and organizing boot camps can help nurture a skilled workforce.

By addressing these challenges and creating an enabling environment, African countries can pave the way for AI development. This, in turn, will lead to job creation, economic growth, and improved quality of life for millions of people in Africa.

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8 PILLAR 5: BUILDING SUSTAINABLE PARTNERSHIPS

8.1 INTRODUCTION

Artificial intelligence (AI) has emerged as a key focal point in the global economy, catalysing economic development and a source of opportunities for social growth and progress. Initially, the advancements in AI were primarily driven by the private sector. However, African governments and their stakeholders have recently shown increasing interest, leading to discussions regarding AI strategies and partnerships to accomplish the following objectives:

a) Advancing the goals outlined in the African Union's Agenda 2063.
b) Implementing country-specific economic interventions and blueprints.
c) Stimulating economic growth, with a particular emphasis on sectors such as agriculture and mining.
d) Supporting activities aimed at human development and social interventions, including education, healthcare, and security.

8.2 STATUS UPDATE ON CONTINENTAL ACTIVITY

In Africa, the sectors with the highest utilisation of AI in their operations are telecommunications, social media, and fintech, predominantly owned and operated by both international and African private sectors. Following closely are interventions in agriculture and health, mainly driven by African governments, their stakeholders, and the private sector.

Fintech, in particular, has witnessed significant growth, impact, and investments across the continent since 2018, with a notable surge in 2020-2021 as a solution for money transfers and payments during the COVID-19 pandemic. Local start-up companies and financial institutions in the private sector predominantly own and operate most of these financial technologies.

In other key areas of Africa's development focus, such as education, security, energy, and industrialisation, we are witnessing the emergence of new ventures led by governments, international stakeholders, and the private sector. However, research on AI in Africa indicates a significant lag in the development and implementation of a comprehensive AI strategy for the continent. The public sector, including African governments, particularly lacks AI infrastructure and human resources. Meanwhile, the major active AI activities primarily revolve around the private sector and international entities in Africa, as highlighted in numerous articles and papers.

8.3 NEED FOR STRATEGIC PARTNERSHIPS FOR AI IN AFRICA

The driving force behind AI activity in Africa encompasses various focus areas that involve private, international, and government stakeholders. However, these stakeholders often face challenges in mobilizing individual resources and establishing infrastructure, which are dispersed throughout the continent. To overcome these obstacles and maximise the impact of AI on continental development, strategic partnerships are crucial. By joining forces and coordinating efforts, these collaborations can yield mutual benefits for all stakeholders involved.

For instance, one example of a strategic partnership in AI is the collaboration between a private technology company, an international organisation, and a government agency to develop an AI-powered healthcare solution. This partnership combines the expertise and resources of the private sector, the global knowledge and support of the international organisation, and the local insights and infrastructure

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of the government agency. Together, they can create an integrated AI solution that addresses healthcare challenges and benefits the entire continent.

Another example could involve a partnership between an international financial institution, a private fintech company, and a government ministry to implement AI-driven solutions for financial inclusion. By combining the financial expertise of the international institution, the technological innovation of the fintech company, and the regulatory support of the government ministry, they can develop inclusive financial services powered by AI. This collaboration would enable greater access to financial resources for underserved populations and contribute to economic growth across the continent.

In both cases, these strategic partnerships leverage the strengths and resources of each stakeholder group, leading to more comprehensive and impactful AI initiatives. By working together, private, international, and government stakeholders can overcome individual limitations and create a synergistic approach that drives sustainable development through AI in Africa.

8.3.1 FOCAL POINTS

a) Identifying the key stakeholders involved in the development and implementation of AI products and modules in Africa.
b) Monitoring the activity, performance, and impact of AI systems across the African continent.
c) Establishing communication structures and legal policies to facilitate collaboration among AI stakeholders in Africa.
d) Allocating resources and assessing skill indexes for the construction and advancement of AI in Africa.
e) Structuring and analysing data to enable forecasting, monitoring, and evaluation of AI activities and stakeholders in Africa.

8.3.2 COSTS OF THE ABSENCE

a) Avoiding duplication of efforts resulting from unidentified AI products and their impacts across the continent can be achieved through profitable or non-profitable partnerships.
b) Leveraging idle resources, particularly shareable knowledge, and skills, to train and educate Africa's youth and human resources on AI.
c) Preventing the loss of opportunities for integrated publicity and awareness of AI.
d) Minimizing delays in achieving continental targets and strategies in technology and digitization by overcoming individualization. This will lead to improved economies of scale in terms of impact, product development, commercialisation, and dissemination of AI modules.
e) Ensuring proper sensitization within the tech and education industries to emphasize the importance of harnessing AI skills as a critical component of their operations. Failure to do so may result in a loss of employment opportunities for Africa's youth.

8.4 GOALS AND TARGETS

a) Identify the relative strengths and shared interests of the various actors involved.
b) Highlight the benefits of collaboration and outline the clear advantages each actor can gain from contributing to a shared pool of resources.
c) Foster the sharing of logistics and expertise among stakeholders, such as private institutions providing skills and training modules to government institutions.
d) Present partnerships as profitable ventures to attract relevant stakeholders.
e) Theme and publicize continental and regional projects to identify interested stakeholders who can contribute.

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f) Initiate discussions among stakeholders in AI and technology to align interests and work towards achieving the goals of the AU's Agenda 2063.
g) Establish a partnership club or organisation to manage relationships among stakeholders and facilitate potential and achievable partnership opportunities.

8.5 STAKEHOLDER MAPPING

8.5.1 AFRICAN CONTEXT OF AFRICA'S AI ECOSYSTEMS

In the context of Africa's AI ecosystem, we can view it as a corporation and aim to identify and analyse the relationships among the stakeholders, as well as characterise their roles within this environment. Embracing an inclusive approach, African countries consider all relevant stakeholders within their respective groups, examining who they are as groups, their activities, and the specific areas they focus on. By mapping out these stakeholders, African countries can gain a comprehensive understanding of their dynamics and contributions to the AI landscape in Africa as shown in Table 6.

Table 6. Stakeholder mapping for national, regional, continental, and international stakeholder partnerships

Stakeholder	**Levels of Engagements**
Tertiary: **International Stakeholders** **Global Stakeholders**	a) Diplomatic, e.g., The African Union, Governments, AUDA-NEPAD, b) Tech Firms, e.g., Microsoft, Google, Meta, Chat GPT. c) Financials and Investments, e.g., African Development Bank, World Bank, Venture Capital Firms. d) Media Houses, e.g., BBC Africa, CNN Africa.
Secondary: **National Stakeholders** **Regional stakeholders**	a) Ministries of Communication, Technology and Innovation, Data Education, Health, etc. b) Non-Governmental Organisations committed to promoting the activities of digitisation, data, technology, AI, and in-country dissemination institutions. c) Local Banks and Financial institutions invested in financial and banking technology. d) Technology giants focused on digitisation, data, and AI product development and deployment. e) Media Houses and Publications. f) Diaspora relations and groups with a focus on technology and development in Africa. g) Angel investors putting in financial and infrastructural resources to promote AI in their regions. h) Legal firms and business registration that specialize in tech legislature, copyrighting patenting and trademarks. i) Formal and informal education institutions.
Primary Stakeholders	a) Technology start-up companies focused on digitisation, data, and AI, especially in areas responsive to AU's Agenda 2063.

	b) Product developers, engineers, entrepreneurs, lawyers, and counsellors who are poised on their engagements in AI as well as open to sharing skills, knowledge, and education materials. c) Bloggers and social media influencers who engage in the dissemination of information on AI and technology in their region.
AI Users	The core users of the AI products such as students, health workers, and industry supervisors, among others.

8.5.2 CONTINENTAL FRAMEWORKS ON SUSTAINABLE PARTNERSHIPS

These activities highlight the engagement needed from the African Union (AU) to build a robust system that leverages the impact and pooling of resources. They can be undertaken among existing and potential stakeholders to harness AI for the socioeconomic development of Africa. The key activities are summarized as follows:

a) Specially prioritizing AI as a core mandate within the AU's pioneering projects.
b) Promoting awareness of AI across the continent as a prerequisite for technology-based activities.
c) Initiating conversations that offer mutual benefits to all stakeholders, including local and international private companies, start-ups, governments, and international bodies within and beyond the continent.
d) Taking actionable continental steps and setting timelines to collaborate with existing and emerging AI initiatives, to foster social and economic growth in Africa.
e) Presenting AI in Africa as an attractive value proposition to engage resourceful stakeholders and encourage investments in AI on the continent.
f) Establishing progressive continental policies on communication and conduct codes among stakeholders to facilitate smooth and ethical collaborations. These policies should emphasize mutual respect, benefits, and the protection of shared resources such as data, skills, software, and educational materials.
g) Encouraging stakeholders to publicize their AI activities and directives to inspire others.
h) Promoting openness in sharing ideas and structures among stakeholders to assist policymakers in creating supportive environments for AI endeavours through well-informed decision-making.
i) Implementing policies for regional capacity strengthening to foster interdependence and provide monitoring support for stakeholders.
j) Seeking to align the cultural, socioeconomic, and political interests of stakeholders with the AU's Agenda 2063 goals.
k) By undertaking these activities, the AU can play a vital role in advancing AI development in Africa, fostering collaboration, and driving progress towards shared socioeconomic objectives.

8.5.3 CREATING AI PARTNERSHIP ECOSYSTEMS

In the context of AI in Africa, strategic partnership ecosystems can play a crucial role in leveraging the competitive advantages and mutual interests of stakeholders, both in the profit and non-profit sectors. These partnerships can have a significant impact on driving AI development and adoption across the continent. The categorization of partnership benefits or outcomes heavily influences the policies that should be established within the partnership agreements to ensure a balanced and effective level of engagement.

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Examples of partnership ecosystems in AI can include:

a) Public-Private Partnerships (PPPs): Collaboration between government entities and private companies can lead to the pooling of resources, expertise, and infrastructure for the development and implementation of AI initiatives. For example, a partnership between a government agency and a technology company to create AI-powered solutions for healthcare delivery in underserved areas.
b) Academic-Industry Collaborations: Universities, research institutions, and AI-focused companies can join forces to drive innovation and knowledge sharing. These collaborations can lead to advancements in AI research, the development of new technologies, and the training of skilled AI professionals. For instance, a partnership between a university's AI research centre and a tech company to jointly develop AI algorithms for autonomous vehicles.
c) Cross-Sector Collaborations: Partnerships that involve stakeholders from different sectors, such as technology, finance, agriculture, and healthcare, can foster interdisciplinary approaches to solving complex challenges using AI. For example, a partnership between a fintech company, an agriculture cooperative, and a data analytics firm to develop AI-driven financial solutions for smallholder farmers.
d) International Collaboration: Partnerships between African countries and international organisations, governments, or companies can facilitate knowledge exchange, capacity building, and access to resources and funding for AI projects. This collaboration can promote cross-border learning and create opportunities for scaling AI solutions. An example could be a partnership between an African country's government and a global AI research institute to establish AI training programmes and support the development of AI start-up companies.

By establishing well-structured partnership ecosystems, African countries can unlock the full potential of AI by leveraging the strengths and resources of various stakeholders. These partnerships can lead to impactful outcomes such as accelerated AI innovation, improved access to AI technologies, enhanced economic growth, job creation, and ultimately, the betterment of the lives of people in Africa.

8.5.4 CONTINENTAL PARTNERSHIP DEEDS

In Africa's AI ecosystem, establishing continental partnership deeds is essential for fostering effective collaborations and ensuring the smooth operation of partnerships. While the specific legal requirements and ethical considerations may vary from country to country, some fundamental elements apply across stakeholders in a partnership. These are summarised as follows:

a) Conversation starters or initiators for partnerships: These are the discussions or engagements that spark the idea of a partnership. For example, a technology company reaching out to a government agency to explore joint AI initiatives in the healthcare sector.
b) Clear intention and contributions: Each party involved in the partnership states their intentions, contributions, and expectations. This clarifies the purpose and goals of the partnership, ensuring alignment among stakeholders. For instance, a university disclosing its expertise in AI research and its commitment to training AI professionals as part of a partnership with a multinational corporation.
c) Business registration and intellectual property protection: Partnerships often involve the exchange of ideas, software, designs, and concepts. Ensuring proper business registration and patenting of intellectual property rights safeguards the interests of all parties involved. This includes protecting software developed jointly or individually within the partnership.
d) Mode of communication and traceability: Establishing clear communication channels and documenting dialogue is essential for effective collaboration. Traceable evidence of discussions and agreements helps in referencing and resolving any potential conflicts or misunderstandings. This can be achieved through written agreements, meeting minutes, or digital communication platforms.

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e) Level of openness and transparency: The partnership should establish guidelines for sharing information, including activities, performance metrics, and impact indexes. Openness fosters trust among stakeholders and enables effective monitoring and evaluation of the partnership's progress.
f) Reporting channels and monitoring: Defining reporting channels ensures that relevant information flows between stakeholders. Monitoring activities within the partnership allows for regular checks on compliance with regional and local ethical standards and guidelines. This helps maintain transparency and accountability.

Effective partnership deeds provide a solid foundation for successful collaborations in Africa's AI ecosystem. By adhering to these requirements, stakeholders can navigate legal and ethical considerations, ensure proper communication and information sharing, protect intellectual property, and uphold standards of transparency and accountability. Ultimately, well-structured partnership deeds contribute to the growth and development of AI in Africa, fostering innovation, knowledge exchange, and socioeconomic progress.

8.6 PARTNERSHIP MATRIX

The partnership matrix illustrates potential collaborations and associations among the mapped stakeholders in the field of AI within and outside Africa. This diagram serves as a simplified representation of the flow of communication and connections between stakeholders. The specific engagements within these partnerships may encompass various elements such as investments, information sharing, data exchange, educational initiatives, publicity efforts, shared skills and knowledge, infrastructure support, and reporting on activity, performance, or impact. These partnerships can be pursued with both profit-oriented and non-profit objectives, fostering a collective drive towards AI development and its positive outcomes.

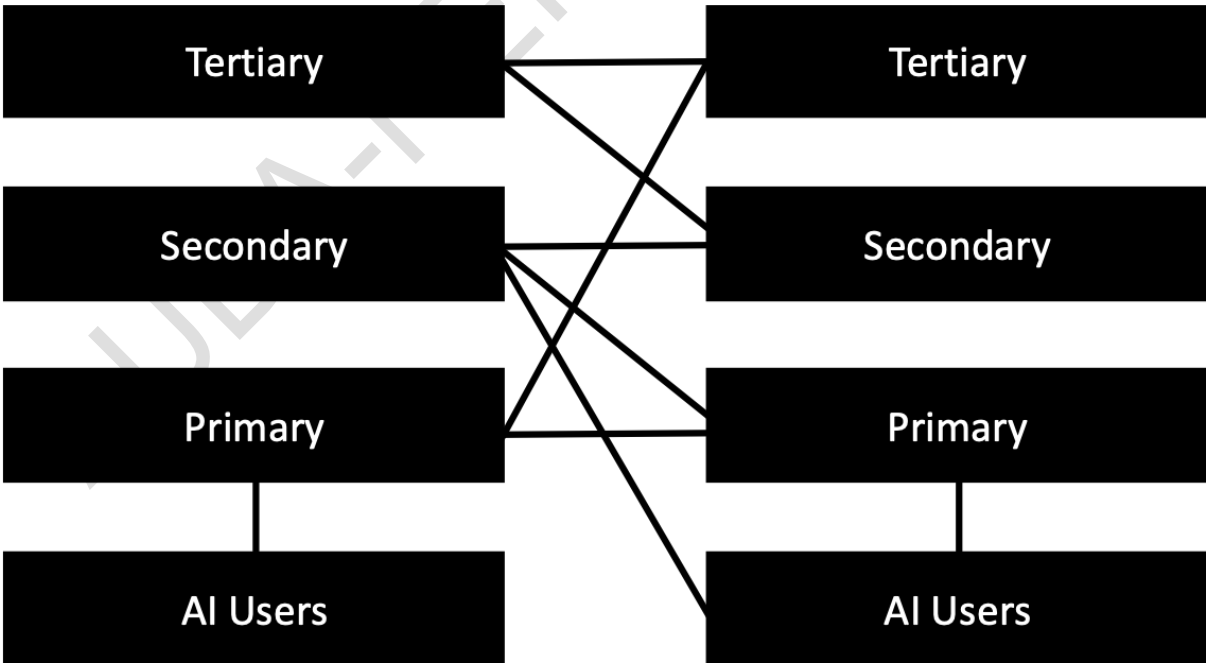

Figure 13: Basic representation of the possible flow of communication and associations among the mapped Africa's AI stakeholders

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8.7 TYPES OF PARTNERSHIPS

Various types of partnerships can exist among the stakeholders identified in the AU - AI stakeholder partnership matrix. These partnerships can be categorized into not-for-profit and for-profit collaborations, each with its objectives and impacts within the African AI ecosystem.

8.7.1 NOT-FOR-PROFIT PARTNERSHIPS:

8.7.1.1 CORPORATE SOCIAL RESPONSIBILITY (CSR) INITIATIVES

Private sector organisations can engage in partnerships that focus on CSR activities related to AI. This includes initiatives aimed at sharing knowledge, skills, and educational materials with local communities to promote AI literacy and skills development.

Here are some examples of multinational technology companies partnering with local schools and universities in Africa to provide AI training programmes and educational resources to students:

a) Microsoft partnered with the African Leadership University (ALU) to launch an AI for Good Fellowship programme. The program provides ALU students with the opportunity to learn about AI and its applications for social good. Fellows work on projects that address challenges such as poverty, hunger, and disease.
b) Google partnered with the University of Cape Town (UCT) to launch an AI for Africa programme. The program provides UCT students with the opportunity to learn about AI and its applications for Africa. Fellows work on projects that address challenges such as healthcare, education, and agriculture.
c) IBM partnered with the Kenya Institute of Curriculum Development (KICD) to develop AI-powered tools for teachers. The tools are designed to help teachers personalise learning for their students and to provide them with feedback on their teaching.
d) Facebook partnered with the University of Lagos (UNILAG) to launch an AI Research Lab. The lab is designed to research AI and its applications for Africa. The lab is also designed to train the next generation of AI researchers in Africa.

These partnerships between multinational technology companies and local schools and universities in Africa to provide AI training programmes and educational resources to students exemplify the numerous collaborations taking place. These initiatives play a pivotal role in equipping students with the necessary skills for the future of work and fostering the development of Africa's AI ecosystem.

Here are some of the impacts of these partnerships:

a) Increased access to AI education. The partnerships between multinational technology companies and local schools and universities are helping to increase access to AI education in Africa. This is important because AI is a rapidly growing field, and there is a high demand for AI skills.
b) Improved quality of AI education. The partnerships between multinational technology companies and local schools and universities are helping to improve the quality of AI education in Africa. This is because multinational technology companies have access to the latest AI research and development, and they can share this knowledge with local schools and universities.
c) Increased interest in AI. The partnerships between multinational technology companies and local schools and universities are helping to increase interest in AI in Africa. This is important because AI has the potential to transform many industries in Africa, such as healthcare, education, and agriculture.

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The partnerships between multinational technology companies and local schools and universities are just one part of the solution to the challenges facing Africa. Other solutions include investing in infrastructure, developing AI talent, and creating a more supportive regulatory environment. However, these partnerships are a good start, and they are helping to make a difference in the lives of millions of people.

8.7.1.2 PUBLICITY AND MEDIA REPORTING

Partnerships in this category involve joint efforts to promote AI initiatives and achievements through media channels. This can include highlighting success stories, organising award systems to recognize AI innovation, and generating public awareness about the potential benefits of AI.

Here are some examples of AI research institutes collaborating with media organisations in Africa to create documentaries and news features that showcase the positive impact of AI in various sectors:

a) The African Institute for Mathematical Sciences (AIMS) partnered with Al Jazeera English to produce a documentary on the use of AI in education in Africa. The documentary, titled "The AI Revolution: The Future of Education in Africa," explores how AI is being used to improve access to education, personalize learning, and provide feedback to students.
b) The University of Cape Town's (UCT) Centre for Artificial Intelligence Research (CAIR) partnered with the Mail & Guardian to produce a series of news features on the use of AI in Africa. The series, titled "AI for Africa," explores how AI is being used to address challenges such as poverty, hunger, and disease.
c) The Kenya Institute of Artificial Intelligence (KIAI) partnered with the Nation Media Group to produce a documentary on the use of AI in healthcare in Kenya. The documentary, titled "AI for Healthcare: The Future of Medicine in Kenya," explores how AI is being used to diagnose diseases, provide personalized treatment, and improve patient care.

These partnerships between AI research institutes and media organisations in Africa exemplify the numerous collaborations being formed to create documentaries and news features that highlight the positive impact of AI across different sectors. Through these partnerships, awareness is raised regarding the potential of AI to significantly enhance the lives of millions of people in Africa.

Here are some of the impacts of these partnerships:

a) Increased awareness of AI. The partnerships between AI research institutes and media organisations are helping to increase awareness of AI in Africa. This is important because AI is a rapidly growing field, and there is a high demand for AI skills.
b) Improved understanding of the potential of AI. The partnerships between AI research institutes and media organisations are helping to improve people's understanding of the potential of AI. This is important because AI has the potential to transform many industries in Africa, such as healthcare, education, and agriculture.
c) Increased support for AI research and development. The partnerships between AI research institutes and media organisations are helping to increase support for AI research and development in Africa. This is important because AI is a long-term investment, and it will take time for AI to reach its full potential in Africa.

The partnerships between AI research institutes and media organisations are just one part of the solution to the challenges facing Africa. Other solutions include investing in infrastructure, developing AI talent, and creating a more supportive regulatory environment. However, these partnerships are a good start, and they are helping to make a difference in the lives of millions of people.

8.7.1.3 REFERRALS AND RECOMMENDATIONS

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Partnerships can facilitate the referral and recommendation of African AI products and services to both continental and global markets. This helps create visibility and market opportunities for local AI firms and start-up companies.

Here are some examples of AI industry associations partnering with trade promotion agencies in Africa to facilitate business connections and referrals for African AI companies seeking international clients:

a) The Association for the Advancement of Artificial Intelligence in Africa (AAAIA) partnered with the South African Trade and Investment Promotion Agency (SA-TIPA) to create a matchmaking platform for African AI companies and international investors. The platform, called the AI Investor Network, allows African AI companies to showcase their products and services to potential investors from around the world.
b) The Kenya Artificial Intelligence Association (KAIA) partnered with the Kenya Export Promotion and Development Authority (KEPSA) to organise a trade mission to the United States for Kenyan AI companies. The trade mission allowed Kenyan AI companies to meet with potential customers and partners in the United States.
c) The Nigeria Artificial Intelligence Society (NAIS) partnered with the Nigerian Export Promotion Council (NEPC) to participate in the World Artificial Intelligence Conference in Paris. The conference allowed NAIS to showcase Nigeria's AI ecosystem to the world, and to connect with potential partners and investors.

These examples highlight the numerous partnerships emerging between AI industry associations and trade promotion agencies in Africa, aimed at facilitating business connections and referrals for African AI companies in their pursuit of international clients. Through these collaborations, the African AI ecosystem is experiencing growth, while creating significant opportunities for African AI companies to thrive in the global market.

Here are some of the impacts of these partnerships:

a) Increased access to international markets. The partnerships between AI industry associations and trade promotion agencies are helping African AI companies to access international markets. This is important because the global market for AI is growing rapidly, and there is a high demand for AI products and services.
b) Increased investment in African AI companies. The partnerships between AI industry associations and trade promotion agencies are helping to attract investment to African AI companies. This is important because investment is essential for African AI companies to grow and scale.
c) Increased collaboration between African AI companies and international partners. The partnerships between AI industry associations and trade promotion agencies are helping to increase collaboration between African AI companies and international partners. This is important because collaboration is essential for African AI companies to learn from the best in the world, and to develop cutting-edge products and services.

The partnerships between AI industry associations and trade promotion agencies are just one part of the solution to the challenges facing Africa. Other solutions include investing in infrastructure, developing AI talent, and creating a more supportive regulatory environment. However, these partnerships are a good start, and they are helping to make a difference in the lives of millions of people.

8.7.2 FOR-PROFIT PARTNERSHIPS

8.7.2.1 COLLABORATIVE INFRASTRUCTURE AND EXPERT RESOURCES

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Partnerships in this category involve pooling resources and expertise to develop AI products and explore business opportunities within the continent. This can include joint research and development projects, shared access to specialised infrastructure, and collaboration on market expansion strategies.

Here are some examples of technology companies partnering with research institutions to develop AI-powered solutions for the agriculture sector in Africa:

a) IBM and the Alliance for a Green Revolution in Africa (AGRA). IBM and AGRA have partnered to develop AI-powered solutions to improve agricultural productivity in Africa. The partnership has resulted in the development of several products, including a mobile app that helps farmers to manage their crops, a satellite-based system that tracks crop yields, and a weather forecasting system that helps farmers to make informed decisions about planting and harvesting.
b) Microsoft and the International Crops Research Institute for Semi-Arid Tropics (ICRISAT). Microsoft and ICRISAT have partnered to develop AI-powered solutions to improve the productivity of smallholder farmers in Africa. The partnership has resulted in the development of several products, including a mobile app that helps farmers to identify pests and diseases, a weather forecasting system that helps farmers to make informed decisions about planting and harvesting, and a financial planning tool that helps farmers to manage their finances.
c) Google and the South African Weather Service. Google and the South African Weather Service have partnered to develop AI-powered solutions to improve weather forecasting in South Africa. The partnership has resulted in the development of a new weather forecasting system that is more accurate and reliable than previous systems. The new system is helping farmers to make better decisions about planting and harvesting and is also helping to protect people from the effects of extreme weather events.

These partnerships between technology companies and research institutions in Africa exemplify the collaborative efforts to leverage AI-powered solutions for the agriculture sector. Through these partnerships, significant strides are being made to enhance agricultural productivity, alleviate food insecurity, and positively impact the lives of millions of individuals.

Here are some of the impacts of these partnerships:

a) Improved agricultural productivity. AI-powered solutions are helping farmers to improve their yields by providing them with better information about pests, diseases, and weather conditions.
b) Reduced food insecurity. AI-powered solutions are helping to reduce food insecurity by helping farmers to produce more food.
c) Improved lives of farmers. AI-powered solutions are helping to improve the lives of farmers by providing them with more income and more free time.

The partnerships between technology companies and research institutions are just one part of the solution to the challenges facing the agriculture sector in Africa. Other solutions include investing in infrastructure, developing new technologies, and providing training and education to farmers. However, these partnerships are a good start, and they are helping to make a difference in the lives of millions of people.

8.7.2.2 VENTURE CAPITAL AND INVESTMENT

Partnerships focused on venture capital investment aim to provide funding and support to AI-focused start-up companies and firms. This helps accelerate their growth, expand their operations, and drive innovation within the African AI ecosystem.

Here are some examples of venture capital firms partnering with AI incubators in Africa to identify promising start-up companies, and provide financial backing, mentorship, and industry connections to fuel their growth:

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a) Ingressive Capital and Andela. Ingressive Capital is a venture capital firm that invests in early-stage African start-up companies. Ingressive Capital partnered with Andela, a talent accelerator that trains and places software developers in companies around the world, to identify promising AI start-up companies in Africa. Ingressive Capital has invested in several AI start-up companies that have been incubated by Andela, including Conversation AI, a company that develops conversational AI products, and 500 Start-up Companies, a startup accelerator that invests in early-stage African start-up companies.
b) Goodwell Investments and m: lab Africa. Goodwell Investments is a venture capital firm that invests in early-stage African start-up companies. Goodwell Investments partnered with m: lab Africa, a mobile innovation lab, to identify promising AI start-up companies in Africa. Goodwell Investments has invested in several AI start-up companies that have been incubated by m: lab Africa, including Ushahidi, a crowdsourcing platform that was used to track the 2008 Kenyan election violence, and Farmerline, a mobile platform that connects farmers to markets and information.
c) The Omidyar Network and Seedstars Africa. The Omidyar Network is a philanthropic investment firm that invests in social enterprises around the world. The Omidyar Network partnered with Seedstars Africa, a startup competition that identifies and invests in early-stage African start-up companies, to identify promising AI start-up companies in Africa. The Omidyar Network has invested in several AI start-up companies that have been selected by Seedstars Africa, including Kobo360, a company that provides access to educational content to students in Africa, and Twiga Foods, a company that delivers fresh produce to retailers in Kenya.

These examples represent a growing number of partnerships between venture capital firms and AI incubators in Africa, showcasing their collaborative efforts to identify and nurture promising AI startup companies on the continent. These partnerships play a vital role in supporting and accelerating the growth of the AI ecosystem in Africa. As such, the partnerships between venture capital firms and AI incubators in Africa are enhancing the capacity to identify, support, and nurture promising AI startup companies. By providing financial resources, mentorship, market access, and knowledge sharing, these partnerships contribute to the growth and success of the AI ecosystem, fostering innovation and economic development in Africa.

Here are some of the impacts of these partnerships:

a) Increased funding for AI start-up companies. Venture capital firms are providing much-needed funding to AI start-up companies in Africa. This funding is helping AI start-up companies to develop their products and services and to scale their businesses.
b) Access to mentorship and industry connections. AI incubators are providing mentorship and industry connections to AI start-up companies in Africa. This mentorship and support are helping AI startup companies to learn from experienced entrepreneurs and to connect with potential customers and partners.
c) Increased awareness of AI in Africa. The partnerships between venture capital firms and AI incubators are helping to raise awareness of AI in Africa. This increased awareness is helping to attract more talent to the AI sector in Africa and to create a more supportive environment for AI start-up companies.

The partnerships between venture capital firms and AI incubators are just one part of the solution to the challenges facing the AI sector in Africa. Other solutions include developing AI talent, building AI infrastructure, and creating a more supportive regulatory environment. However, these partnerships are a good start, and they are helping to make a difference in the lives of millions of people.

8.7.2.3 CONTINENTAL AND LOCAL PROCUREMENT DEALS

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Partnerships can be established to facilitate procurement deals between African AI firms and start-up companies and continental or local entities. These partnerships create opportunities for AI companies to secure contracts and generate revenue through the provision of AI products and services.

Here are some examples of government agencies partnering with local AI companies in Africa to procure AI-driven analytics software for monitoring and evaluation purposes:

a) The Kenyan government partnered with Ushahidi, a crowdsourcing platform, to use AI to monitor and evaluate the distribution of food aid during the 2011 famine. Ushahidi's AI-powered platform was able to track the distribution of food aid in real time and to identify areas where there were shortages. This information was used by the Kenyan government to ensure that food aid was reaching those who needed it most.
b) The South African government partnered with a local AI company to use AI to monitor and evaluate the implementation of its national health plan. The AI-powered software was able to track the progress of the plan and identify areas where there were problems. This information was used by the South African government to make changes to the plan and to ensure that it was meeting its goals.
c) The Nigerian government partnered with a local AI company to use AI to monitor and evaluate the implementation of its education reform program. The AI-powered software was able to track the progress of the programme and to identify areas where there were problems. This information was used by the Nigerian government to make changes to the programme and to ensure that it was meeting its goals.

These examples showcase the increasing number of partnerships in Africa between government agencies and local AI companies with a focus on leveraging AI for monitoring and evaluation purposes. These collaborations offer numerous advantages that enhance the efficiency and effectiveness of government programmes, ensuring that assistance reaches the intended beneficiaries most effectively.

Here are some of the impacts of these partnerships:

a) Improved efficiency and effectiveness of government programmes. AI-powered analytics software is helping governments to improve the efficiency and effectiveness of their programmes by providing them with real-time data and insights. This data and insights can be used to identify problems, make changes to programmes, and ensure that programmes are meeting their goals.
b) Improved targeting of government programmes. AI-powered analytics software is helping governments to improve the targeting of their programmes by providing them with data on who is most likely to benefit from them. This data can be used to ensure that programmes are reaching those who need them most.
c) Increased transparency and accountability of government programmes. AI-powered analytics software is helping governments to increase transparency and accountability of their programmes by providing them with data on how programmes are being implemented and how they are impacting people. This data can be used to ensure that programmes are being implemented in a way that is consistent with government policies and that they are having a positive impact on people.

The partnerships between government agencies and local AI companies are just one part of the solution to the challenges facing governments in Africa. Other solutions include investing in education and training, building AI infrastructure, and creating a more supportive regulatory environment. However, these partnerships are a good start, and they are helping to make a difference in the lives of millions of people.

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Table 7. Types of Partnerships and their Responsibilities

TYPE OF PARTNERSHIPS	RESPONSIBILITIES
Not For Profit	a) Cooperate with social responsibility for the private sector. b) Sharing of knowledge, skills, and educational material. c) Publicity, award systems, and media reporting. d) Referrals and recommendations of African AI products to continental and global markets.
For Profit	a) Collaborating infrastructure and expert resources to build AI products and products to explore continental business opportunities. b) Venture capitalizing and investing in start-ups and AI-focused firms. c) Continental and local procurement deals exclusive to African AI firms and start-up companies.

These partnerships, regardless of their profit orientation, hold immense potential in propelling AI development, fostering innovation, and driving economic growth and social progress in Africa. By joining forces and combining resources, these collaborations can unlock new opportunities and create synergies that positively impact various sectors and communities across the continent. Through shared expertise, knowledge exchange, and joint efforts, these partnerships contribute to the advancement of AI technologies, promote entrepreneurship, create employment opportunities, and ultimately uplift societies in Africa.

8.8 THE ROLE OF AU MEMBER STATES

The regional and local in-country integration of AI into the social economic development of AU Member States is crucial to the deployment of AI models, hence the generation of feedback and progressive improvement to address challenges and maximize the potential of emerging technologies. These should include community engagements to publicise the use and benefits of AI through mass media platforms, highlight the development and accessibility of AI technologies, ensure that AI is portrayed as a non-threatening resource, and disseminate AI products to reach all demographic levels of the population.

Community engagements play a crucial role in promoting the use and benefits of AI in Africa. This can be achieved through various strategies. Firstly, publicizing the use and advantages of AI through mass media platforms helps raise awareness and understanding among the general population. Secondly, highlighting the development and accessibility of AI technologies showcases the opportunities they present for individuals and communities. It is essential to ensure that AI is portrayed as a non-threatening resource, addressing any concerns or misconceptions that may exist. Lastly, disseminating AI products to reach all demographic levels of the population ensures inclusivity and equal access, enabling everyone to benefit from AI advancements in Africa.

Collaborating in AI infrastructure is essential for the advancement of AI in Africa. AU Member States are taking proactive measures to promote collaboration both within their own countries and among neighbouring nations. Firstly, they are implementing policies to encourage "intra collaborations" by facilitating the sharing of infrastructure such as data centres and computer laboratories among

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stakeholders within the country. This promotes resource efficiency and enables a collaborative environment for AI development. Secondly, policies are being established to foster "inter collaborations" between neighbouring countries, with a specific focus on sharing resources to address common challenges faced by farmers in the region. This includes initiatives related to irrigation, pest control, and other agricultural issues.

Furthermore, knowledge and expertise exchange among the AU Member States are being actively encouraged. By sharing best practices and experiences, countries can enhance their agricultural practices and improve resource utilisation leading to increased efficiency and productivity. To facilitate cross-border partnerships and cooperation in addressing agricultural challenges, platforms and initiatives are being created. These initiatives promote sustainable development and food security across the continent by fostering collaboration and sharing of resources, expertise, and technologies. Additionally, joint research and development projects are being implemented, leveraging shared resources, innovative technologies, and best practices. This collaboration aims to improve agricultural productivity and address common challenges in the region, leading to significant advancements in the agricultural sector across Africa.

Table 8. The Role of AU Member States and Stakeholders and Outcomes

STAKEHOLDERS	OUTCOMES
The Role of AU Member States	a) Integration of AI into social economic development. b) Deployment of AI models and generating feedback for improvement. c) Maximising the potential of emerging technologies.
Community engagements	a) Publicizing the use and benefits of AI through mass media platforms b) Highlighting the development and accessibility of AI technologies c) Portraying AI as a non-threatening resource d) Disseminating AI products to reach all demographic levels.
Collaborating in AI infrastructure	a) Intra-country collaborations to share infrastructure among stakeholders. b) Inter-country collaborations to address common issues and benefit specific sectors. c) Knowledge and expertise exchange among Member States. d) Platforms and initiatives for cross-border partnerships and cooperation. e) Joint research and development projects to improve productivity and address challenges.
Diaspora Relations	a) Implementing diaspora engagement policies. b) Financial investment channels and mechanisms. c) Skill transfer and knowledge-sharing programmes. d) Recognition of foreign qualifications. e) Engaging diaspora networks and fostering collaboration. f) Creating investment and entrepreneurship opportunities.

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	g) Promoting knowledge exchange and research collaborations. h) Recognising diaspora contributions to development.
Academia-industry partnerships	a) Collaborative research projects. b) Internship and apprenticeship programmes. c) Curriculum development with industry stakeholders. d) Industry-sponsored research grants. e) Technology transfer and commercialisation. f) Continuing education and professional development. g) Industry advisory boards. h) Joint conferences and symposiums. i) Funding and sponsorship opportunities. j) Industry mentorship programmes.
International governance and collaboration	a) International standards and frameworks for AI. b) Knowledge sharing and capacity building and strengthening. c) Funding and investment partnerships. d) Research collaborations with international institutions. e) Policy harmonization and regulatory cooperation f) Public-private partnerships. g) Collaborative projects and initiatives. h) Talent exchange and mobility programmes i) Data sharing and collaborations. j) Advocacy and representation in international AI governance discussions.

Diaspora relations play a crucial role in the development, implementation, and strengthening of the AI economy in Africa. To leverage the resources and expertise of the African diaspora, governments can implement diaspora engagement policies. These policies aim to encourage diaspora members to invest financially and contribute their skills and expertise to support development efforts in their home countries. Incentives, programmes, and initiatives can be introduced to create an enabling environment for diaspora engagement. As such, creating financial investment channels is another important aspect of diaspora relations. Establishing mechanisms and channels that enable diaspora members to invest in various sectors, such as infrastructure, entrepreneurship, and social impact projects, can greatly contribute to the growth of the AI economy. This can be achieved through the establishment of investment funds, offering tax incentives, and simplifying remittance processes.

Skill transfer and knowledge-sharing programmes are essential for harnessing the expertise of the diaspora. Developing programmes that facilitate the transfer of skills and knowledge from diaspora professionals to local communities can have a significant impact on AI development. Mentorship programmes, exchange programmes, and partnerships between diaspora experts and local institutions can be established to facilitate this transfer of knowledge. Thus, recognising and simplifying the recognition of foreign qualifications held by diaspora members is crucial. By removing unnecessary barriers, diaspora professionals can contribute their expertise in sectors such as healthcare, education, and technology, effectively utilizing their skills for the advancement of AI in Africa.

Engaging diaspora networks and organisations are also important for fostering collaboration and knowledge exchange. Establishing diaspora-specific platforms, events, and conferences can provide opportunities for networking, collaboration, and sharing of ideas. This can further enhance the involvement of the diaspora in AI development and implementation efforts. In addition, policies that

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support diaspora-led investment and entrepreneurship initiatives should be developed. Providing access to funding, mentorship, and business development support can encourage diaspora members to establish businesses and contribute to the economic growth of their home countries.

Encouraging research collaborations between diaspora researchers and local institutions is vital for knowledge exchange and innovation. By funding research projects, organizing conferences, and establishing partnerships between diaspora research networks and local academic institutions, valuable collaborations can be fostered to advance AI research in Africa. Fundamentally, recognising and celebrating the contributions of the diaspora to their home countries' development is crucial. This can be done through awards, recognition programmes, and public campaigns that highlight successful diaspora initiatives and showcase their positive impact on various sectors of society.

Academia-industry partnerships are crucial for fostering innovation, addressing industry challenges, and bridging the gap between theory and practice. To strengthen these partnerships in Africa, several strategies can be implemented. Firstly, collaborative research projects can be facilitated, bringing together academia and industry to jointly address specific challenges, develop innovative solutions, and contribute to industry advancement. By leveraging the expertise and resources of both sectors, these research projects can drive meaningful outcomes. Secondly, internship and apprenticeship programmes can be established to provide students with practical industry experience. These programmes enable students to apply their academic knowledge in real-world settings, enhancing their employability and fostering collaboration between educational institutions and businesses. By immersing students in industrial environments, they can gain valuable insights and skills while also contributing to industry projects.

Curriculum development is another key aspect of academia-industry partnerships. Engaging industry stakeholders in the development of academic curricula ensures that the skills taught align with industry needs. By involving industry experts as guest lecturers, advisory board members, or contributors to course content, academic institutions can stay up to date with industry trends and equip students with relevant knowledge and skills. Furthermore, industry-sponsored research grants play a vital role in incentivizing collaboration between academia and industry. Encouraging the industry to sponsor research grants and provide funding for academic research projects promotes knowledge transfer and drives research innovation in areas relevant to industry needs. By aligning research priorities with industry demands, academia can make a significant impact on solving real-world challenges.

To facilitate the transfer of research outcomes into practical applications, mechanisms for technology transfer and commercialisation should be established. This can involve supporting the creation of spin-off companies, licensing intellectual property, and fostering entrepreneurship among academic researchers. By translating research innovations into tangible products or services, academia and industry can jointly contribute to economic growth and societal benefit.

Continuing education and professional development programmes are essential for keeping up with industry trends. Collaborating to provide industry-relevant training programmes and opportunities for both students and industry professionals ensures that skills remain up-to-date and aligned with the evolving demands of the industry. Workshops, seminars, and online courses can address emerging trends, technologies, and skills required for success in the industry. Hence, establishing industry advisory boards comprising representatives from different sectors can provide valuable guidance to academic institutions. These boards offer insights on industry trends, skills requirements, and research priorities, helping academic programmes stay connected to industry needs. By involving industry professionals in curriculum development and strategic decision-making, universities can adapt their programmes to meet industry demands effectively.

Joint conferences, symposiums, and networking events are ideal platforms for academia and industry stakeholders to come together. These events facilitate knowledge sharing, foster collaboration, and create opportunities for showcasing work and exploring potential partnerships. By bringing academics and industry professionals under one roof, these platforms encourage meaningful exchanges and pave the way for future collaborations. Thus, seeking industry sponsorship and funding for academic

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research, scholarships, and infrastructure development can alleviate financial constraints and promote collaboration. By partnering with the industry in funding initiatives, academic institutions can enhance the quality and impact of their programmes and research initiatives.

Establishing industry mentorship programmes can connect students and researchers with industry professionals who can provide guidance, career advice, and networking opportunities. These mentorship programmes play a crucial role in nurturing talent, supporting career development, and ensuring a smooth transition from academia to industry. Overall, academia-industry partnerships in Africa can be strengthened through collaborative research projects, practical industry experience programmes, curriculum development, research grants, technology transfer, professional development opportunities, industry advisory boards, joint conferences, funding opportunities, and mentorship programmes. These strategies foster collaboration, enhance the relevance of academic programmes, and drive innovation and economic growth.

International governance and collaboration play a crucial role in shaping the development, deployment, and responsible use of AI in Africa. To strengthen this collaboration, several strategies can be pursued. Firstly, collaborating with international organisations and governing bodies to develop and adopt common standards, frameworks, and ethical guidelines for AI in Africa ensures interoperability, fairness, and accountability. By aligning with international norms, African countries can promote responsible AI practices and build trust in AI systems. Secondly, fostering knowledge sharing and capacity building through international collaboration platforms facilitates the exchange of best practices, research findings, and expertise in AI. Partnerships with international institutions, universities, and research centres can support capacity-building programmes, workshops, and training initiatives for African stakeholders. By leveraging global knowledge, African countries can accelerate their AI capabilities and ensure the adoption of AI solutions that are tailored to local contexts. Thirdly, forging partnerships with international funding agencies, development banks, and investors can attract investment and financial support for AI projects in Africa. Joint funding initiatives, grants, and venture capital investments can stimulate AI innovation and entrepreneurship in the region, unlocking economic growth and societal benefits.

Additionally, establishing collaborative research projects and networks with international institutions and researchers addresses complex AI challenges and leverages global expertise. Joint research grants, academic exchanges, and collaborative publications can advance AI research in Africa, fostering innovation and driving impactful solutions. Hence, engaging in international forums and initiatives for policy harmonization and regulatory cooperation is crucial. Harmonizing AI policies, regulations, and legal frameworks across countries facilitates cross-border collaborations, and data sharing, and ensures consistency in ethical and legal considerations related to AI deployment.

Furthermore, fostering public-private partnerships between African governments, international organisations, and multinational corporations can accelerate AI development and adoption in Africa. Joint initiatives can focus on developing AI infrastructure, promoting technology transfer, and facilitating market access for African AI companies. Therefore, participating in international collaborative projects and initiatives focused on AI development in Africa strengthens collaboration with international organisations, research consortia, and industry alliances. By addressing specific AI challenges in areas like healthcare, agriculture, or education, with a focus on African contexts, African countries can leverage international expertise and drive meaningful impact.

Facilitating talent exchange programmes, scholarships, and internships allows African AI professionals, researchers, and students to collaborate with international institutions, gaining exposure to global AI advancements. This promotes skills development, and cultural exchange, and fosters international collaboration in AI. As such, encouraging international collaborations for data sharing and partnerships with diverse datasets enhances innovation and training of AI models with representative data from different regions. By accessing a variety of data sources through partnerships with international organisations, governments, and private entities, African countries can improve the accuracy and inclusivity of AI technologies.

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Most importantly, active participation in international AI governance discussions and platforms ensures that African perspectives, interests, and priorities are represented. Advocating for inclusive AI policies, addressing biases and discrimination, and promoting equitable access to AI technologies and benefits for African nations are crucial in shaping the global AI landscape. By actively engaging in international dialogue, African countries can contribute to the development of AI governance frameworks that reflect their unique needs and aspirations.

8.9 COORDINATING AND SUSTAINING STAKEHOLDER DATABASES AND NETWORKING PLATFORMS AND COMMUNITIES

A real-time digital community for stakeholders (start-up companies, government agencies, international organisations, multinational tech companies, experts, academic and research institutions) should be established to review existing and upcoming AI products, collect, and analyse data, share skills and resources, and collaborate to embark on actionable projects on mutual interest. The availability of the data will also help in the progressive direction of strategies to maximize the benefits and essentials of existing and potential partnerships.

The establishment of a real-time digital community for AI stakeholders in Africa would have several positive impacts. It would help to:

a) Increase collaboration between stakeholders. This would lead to the development of better AI products and services.
b) Accelerate the development of the AI ecosystem in Africa. This would create jobs and opportunities for Africans.
c) Make Africa a leader in the global AI race. This would benefit the continent economically and socially.

Here are some examples of how this could be done in Africa in 2023:

8.9.1 THE AFRICAN ARTIFICIAL INTELLIGENCE FOUNDATION

The African Artificial Intelligence Foundation (AAIF) could create a digital community for African AI stakeholders. The AAIF could use the community to connect stakeholders, share resources, and collaborate on projects. Here are some examples of how the African Artificial Intelligence Foundation (AAIF) could create a digital community for African AI stakeholders:

a) The AAIF could create a website or online forum for African AI stakeholders to connect and share information. The website or forum could include features such as discussion boards, job boards, and resource directories.
b) The AAIF could host regular events, such as conferences, meetups, and hackathons, for African AI stakeholders to meet and collaborate. These events could provide opportunities for stakeholders to share ideas, learn from each other, and build relationships.
c) The AAIF could provide funding for African AI projects. This funding could be used to support the development of new AI products and services, as well as the training of AI talent.
d) The establishment of a digital community for African AI stakeholders would have several positive impacts. It would help to:
e) Increase collaboration between African AI stakeholders. This would lead to the development of better AI products and services.
f) Accelerate the development of the AI ecosystem in Africa. This would create jobs and opportunities for Africans.
g) Make Africa a leader in the global AI race. This would benefit the continent economically and socially.

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Here are some specific examples of how the AAIF could use the digital community to connect stakeholders, share resources, and collaborate on projects:

a) The AAIF could connect start-up companies with government agencies and multinational tech companies. This could lead to new partnerships that could help start-up companies to scale their businesses.
b) The AAIF could connect researchers with academic and research institutions. This could lead to new collaborations that could lead to breakthroughs in AI research.
c) The AAIF could connect policymakers with stakeholders. This could lead to the development of policies that support the development of AI in Africa.

The establishment of a digital community for African AI stakeholders holds immense value for the advancement of the AI ecosystem in Africa. This platform would serve as a crucial resource, connecting stakeholders from various sectors and facilitating the sharing of resources, knowledge, and expertise. Through collaboration on projects of mutual interest, this community would drive the development of superior AI products and services, ensuring their relevance and effectiveness in addressing African challenges. Moreover, by fostering connections and collaborations, the digital community would accelerate the growth of the AI ecosystem in Africa, fuelling innovation, creating employment opportunities, and attracting investments. Ultimately, this concerted effort would position Africa as a leader in the global AI race, contributing to the continent's economic growth, technological progress, and societal transformation.

8.9.2 GOVERNMENT AGENCIES

Government agencies could use the community to collect data on AI adoption and use in Africa. This data could be used to inform policy decisions and to support the development of the AI ecosystem in Africa. here are some examples of how government agencies could use the digital community to collect data on AI adoption and use in Africa:

a) Government agencies could ask stakeholders to complete surveys about their use of AI. This data could be used to track the adoption of AI in different sectors of the economy.
b) Government agencies could require AI companies to submit data about their products and services. This data could be used to assess the impact of AI on the economy and society.
c) Government agencies could monitor social media and other online platforms for discussions about AI. This data could be used to identify emerging trends in AI adoption and use.

The data collected by government agencies could be used to inform policy decisions. For example, the data could be used to:

a) Identify sectors of the economy where AI could be used to improve productivity or create jobs.
b) Develop policies to promote the responsible use of AI.
c) Address the potential risks of AI, such as job displacement and bias.

The data collected by government agencies could also be used to support the development of the AI ecosystem in Africa. For example, the data could be used to:

a) Identify areas where there is a need for training and support for AI developers.
b) Develop programmes to encourage the adoption of AI by businesses and organisations.
c) Promote the development of AI products and services that meet the needs of Africans.

The establishment of a digital community for African AI stakeholders would serve as a valuable resource for government agencies in Africa. This platform would enable government agencies to collect data on the adoption and use of AI technologies across various sectors, providing valuable insights into the state of AI implementation and its impact. By leveraging this data, government agencies could make

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informed policy decisions that promote the responsible and effective use of AI, while addressing any challenges or gaps in the AI ecosystem. The availability of such data would also support the development of comprehensive strategies and initiatives to foster the growth of the AI sector in Africa, driving innovation, job creation, and economic growth. Ultimately, this digital community would empower government agencies to harness the transformative potential of AI and steer its development in a direction that aligns with national priorities and societal needs.

8.9.3 MULTINATIONAL TECHNOLOGY COMPANIES

Multinational technology companies could use the community to connect with African AI start-up companies and researchers. This could lead to new partnerships and collaborations that could help to accelerate the development of AI in Africa. Here are some examples of how multinational technology companies could use the digital community to connect with African AI start-up companies and researchers:

a) Multinational technology companies could post job openings in the community. This could help them to find talented AI developers in Africa.
b) Multinational technology companies could sponsor events and hackathons in the community. This could help them to connect with African AI start-up companies and researchers.
c) Multinational technology companies could provide funding for African AI projects. This could help them to support the development of new AI products and services.
d) The establishment of a digital community for African AI stakeholders would be a valuable resource for multinational technology companies. It would help them to connect with African AI start-up companies and researchers, and to collaborate on projects that could accelerate the development of AI in Africa.

Here are some specific examples of how multinational technology companies could use the digital community to connect with African AI start-up companies and researchers:

a) Google could use the community to connect with African AI start-up companies that are developing new applications for its AI technologies. This could lead to new partnerships that could help Google to expand its reach in Africa.
b) Microsoft could use the community to connect with African AI researchers who are working on new ways to use its AI technologies to solve social problems. This could lead to new collaborations that could help Microsoft to make a positive impact on Africa.
c) IBM could use the community to connect with African AI start-up companies that are developing new AI-powered products and services for the African market. This could lead to new partnerships that could help IBM to grow its business in Africa.

The establishment of a digital community for African AI stakeholders would create a win-win situation for multinational technology companies and African AI start-up companies and researchers. This platform would provide a valuable opportunity for multinational technology companies to connect with the vibrant talent pool of African AI professionals, start-up companies, and researchers. By collaborating with African stakeholders, these companies could tap into the local expertise, innovative ideas, and unique perspectives, which could accelerate the development of AI in Africa and create mutually beneficial partnerships.

On the other hand, African AI start-up companies and researchers would benefit from this community by gaining access to the vast resources, knowledge, and networks of multinational technology companies. This collaboration would enable them to enhance their skills, receive mentorship, and potentially secure investments or partnerships that could fuel their growth and success. Overall, the digital community would foster meaningful connections, knowledge exchange, and collaboration, creating a positive ecosystem where multinational technology companies and African AI start-up companies and researchers can thrive together.

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8.9.4 ACADEMIC AND RESEARCH INSTITUTIONS

Academic and research institutions could use the community to share research and resources. This could help to build a strong AI research community in Africa. Here are some examples of how academic and research institutions could use the digital community to share research and resources:

a) Academic and research institutions could post their research papers and datasets in the community. This could help other researchers to access their work.
b) Academic and research institutions could host online courses and tutorials on AI. This could help students and professionals to learn about AI.
c) Academic and research institutions could organise regular events, such as conferences, workshops, and hackathons, on AI. This could help researchers to network and collaborate.
d) The establishment of a digital community for African AI stakeholders would be a valuable resource for academic and research institutions. It would help them to share research and resources, and to build a strong AI research community in Africa.

Here are some specific examples of how academic and research institutions could use the digital community to share research and resources:

a) The University of Cape Town (UCT) could use the community to share its research on using AI to improve healthcare in Africa. This could help other universities and research institutions to learn from UCT's work.
b) The Kenya Institute of Artificial Intelligence could use the community to share its datasets on African languages. This could help other researchers to develop AI applications that can understand and process African languages.
c) The University of Nigeria could use the community to host an online course on AI for social good. This could help students and professionals to learn how to use AI to solve social problems in Africa.

The establishment of a digital community for African AI stakeholders would bring significant benefits to both academic and research institutions as well as the African AI research community. This platform would provide a valuable space for academic and research institutions to share their research findings, resources, and expertise within the field of AI. By connecting with other stakeholders, these institutions could foster collaborations, exchange knowledge, and build a strong AI research community in Africa. This community would serve as a hub for researchers to access the latest research advancements, stay updated with emerging trends, and enhance their research skills.

Additionally, it would offer opportunities for networking, mentorship, and collaborative projects, enabling the African AI research community to further develop their skills and contribute to the advancement of AI in Africa. Ultimately, the digital community would facilitate the growth of a vibrant and collaborative research environment, strengthening the capacity and impact of academic and research institutions while nurturing a thriving African AI research community.

8.10 RECOMMENDATIONS

Below are some recommendations to build and strengthen sustainable partnerships, summarised as follows:

8.10.1 POLICY ON COMMUNICATION STRATEGY FOR PARTNERSHIPS IN AI, AND AI AS WHOLE

AI in Africa requires a versatile digital and physical identity that embodies a personified and futuristic solution and assistance module. This identity would have a significant positive impact on our socioeconomic lives, empowering individuals and communities with advanced technologies and

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capabilities. By leveraging this versatile identity, Africa can unlock the potential of AI to drive innovation, enhance productivity, address societal challenges, and create new opportunities for economic growth and development.

a) To engage tertiary, secondary, and primary stakeholders effectively, it is essential to establish policies that prioritise a robust communication strategy. This strategy should highlight the value proposition of AI in Africa, positioning it in a formal context on both continental and global scales. By doing so, we can attract investments and foster meaningful engagements, making the AI venture in Africa more compelling and worthwhile.

b) For policymakers, it is crucial to provide reports on how AI is addressing development in local and regional socio-cultural and economic sectors. Additionally, it is important to identify the stakeholders involved in these activities. This information serves the purpose of monitoring and regulation, ensuring conformity and responsible implementation of AI technologies.

c) Users of AI would greatly benefit from a comprehensive continental communication strategy encompassing campaigns, education, advertisements, and mass media efforts. Such a strategy aims to raise public awareness about the uses, implementations, advantages, user-friendliness, potentials, and accessibility of existing and upcoming AI interventions. By implementing this strategy, users can make informed decisions and fully harness the transformative power of AI in their daily lives.

8.10.2 POLICY ON DATA FOR PARTNERSHIP IN AI LOCAL, REGIONAL & CONTINENTAL STRATEGIES

The policy recommendations to foster partnerships at local, regional, and continental levels, were summarised as follows:

a) African countries should prioritise the future of work and foster collaboration among stakeholders in the AI sector. By encouraging independent initiatives and promoting collaborative efforts, Africa can harness the potential of AI to shape the future of work, creating opportunities for economic growth, job creation, and skill development across various sectors.

b) African Member States should establish a robust legal framework and advisory system to facilitate partnerships and standardise modes of communication, such as patenting and copyrights, to protect intellectual property rights. By ensuring clear guidelines and regulations, Africa can promote innovation, encourage collaboration, and provide a secure environment for the development and commercialisation of AI technologies, fostering growth and attracting investment in the region.

c) Africa should prioritise the identification of AI activities, monitor progress, and facilitate the sharing of resources and networking opportunities across the continent. By establishing a comprehensive AI network system for tracking and assessing ongoing initiatives, Africa can promote collaboration, leverage shared resources, and facilitate knowledge exchange. This approach will foster synergy, enhance efficiency, and accelerate the development and adoption of AI technologies throughout the region.

d) African countries should develop modules dedicated to publicising and creating awareness for existing AI models. By implementing effective communication strategies and outreach programmes, African countries can ensure that the public is informed about the availability and potential benefits of AI solutions. These modules will play a key role in promoting understanding, trust, and widespread adoption of AI technologies across various sectors, driving socioeconomic development and empowerment throughout the continent.

e) Africa should establish a regional and/or country-based digital survey and questionnaire structure. This framework would enable systematic data collection and analysis, providing valuable insights into the AI landscape across different regions and countries. By implementing

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such a structure, Africa can gain a comprehensive understanding of the opportunities, challenges, and specific needs related to AI adoption and development. This knowledge will inform effective policymaking, foster collaboration, and facilitate targeted interventions to maximize the positive impact of AI partnerships in the region.

f) Africa should prioritise the identification and listing of stakeholders, both local and international. This includes identifying conversation starters, assessing the level of interest, and evaluating commitments from these stakeholders. By having a comprehensive understanding of the relevant actors and their engagement, Africa can foster effective collaborations, build strong networks, and ensure meaningful partnerships that drive the advancement of AI across the continent.

g) Africa should also establish clear mutual expectations and foster favourable modes of collaboration for both existing and potential stakeholders. By promoting transparency, trust, and effective communication, Africa can facilitate productive partnerships that align the interests and goals of all involved parties. This approach will not only encourage active engagement but also enhance the likelihood of successful collaborations, driving the adoption and implementation of AI technologies for the benefit of the continent.

h) Africa should identify the core areas of interest, particularly those related to socioeconomic development, that can foster progressive partnerships and collaborations among stakeholders. By focusing on these key areas, such as education, healthcare, agriculture, and entrepreneurship, Africa can create a conducive environment for meaningful engagement and collaboration in the AI sector. This approach will promote innovation, address societal challenges, and drive sustainable growth, ultimately benefiting the continent as a whole.

8.10.3 A STRATEGY COMMITTEE FOR AI PARTNERSHIPS AND ECONOMY IN AFRICA

The AU should establish a Strategy Committee for AI Partnerships and the Economy. This committee, appointed by the African Union, would consist of experts tasked with monitoring and evaluating the activities of AI and its impact across the continent. The focus would be on leveraging AI partnerships and economic opportunities to drive sustainable and progressive development in Africa's socioeconomic landscape.

Key points for the policy recommendation:

a) Appointment of Expert Committee: The AU should appoint a team of experts in AI to form a dedicated Strategy Committee. This committee will be responsible for overseeing and evaluating AI activities and their impact in Africa.
b) Focus on AI Partnerships: The Strategy Committee should prioritise fostering partnerships in the AI sector. By encouraging collaborations between local and international stakeholders, Africa can harness the expertise and resources needed for AI-driven development.
c) Economic Development Integration: The Strategy Committee should ensure that AI initiatives are closely integrated into Africa's socioeconomic development plans. This approach will maximize the potential of AI technologies to drive inclusive growth, job creation, and improved living standards across the continent.

By implementing these policy recommendations, Africa can position itself as a leader in AI development, ensuring sustainable progress and reaping the benefits of this transformative technology.

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9 CONCLUSION

In conclusion, AUDA-NEPAD and APET advises that African countries should formulate accompanying legislation and laws to facilitate the adoption of AI, especially in countries where AI strategies and regulatory frameworks are lacking. Showcasing ongoing AI activities and plans can demonstrate the potential impacts and outputs of the AI economy in Africa. Therefore, to enhance the impact of AI, there should be a focus on strengthening human capital development and skills in AI. The continental strategy should address the challenges and opportunities for the youth, include case studies of AI in human capacity building, and consider the diverse languages spoken in Africa to ensure AI is relevant and accessible to local communities.

Ethical considerations should be integrated into AI policies, with a focus on data protection, the safety of AI systems, and stakeholder perspectives. Training and enabling AI jobs and entrepreneurship within the public and private sectors should be prioritised, and women's representation in technology should be emphasised. Furthermore, infrastructure and data foundations should be considered, including efficient and reliable energy sources for data centres and data ownership policies that encourage local access and utilization. Skills development in data governance should be promoted to enable collaborations and sharing of infrastructure.

Creating an enabling environment for AI deployment can be achieved through self-regulation and incentives for self-reporting. Incentives may include access to data auditing, license renewal, and penalty reduction for self-reporting of AI ethics violations. Additionally, to promote the AI economy, domestic funding mechanisms, public-private investments, and security measures for AI systems should be developed. Research and innovation should focus on generating local solutions for African challenges. Furthermore, incentives such as tax waivers, subsidies, and local funding mechanisms can support AI businesses, start-ups, and entrepreneurship. Sustainable partnerships should be established, encompassing joint ventures, skills transfer, innovation, technology, finance, capacity building, and trade.

Finally, AUDA-NEPAD emphasises that these policy recommendations should be implemented within the framework of strategic partnerships, progress monitoring, and evaluation. The African Union can play a crucial role in facilitating and coordinating these partnerships and generating progress reports to enhance competitiveness and improve AI initiatives and centres of excellence across African countries. Regular measurement of AI readiness and progress can strengthen the AI ecosystem and drive continuous improvement.

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