

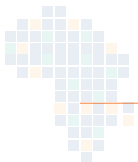


BLUEPRINT

ARTIFICIAL INTELLIGENCE FOR AFRICA

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LIST OF ACRONYMS

AI= Artificial intelligence

AIMS = African Institute of Mathematical Sciences

ARSO= African Organisation for Standardization

AU = African Union

BRAIN=Building a Responsible AI Nation

CAIR= Centre for Artificial Intelligence Research

EU = European Commission

GIZ= Deutsche Gesellschaft für Internationale Zusammenarbeit

GDP = Gross Domestic Product

GDPR = General Data Protection Regulation

ICHOM = International Consortium for Health Outcomes Measurement

IEEE = Institute of Electrical and Electronics Engineers

ML = Machine Learning

MOOC= Massive Open Online Courses

OECD = Organisation for Economic Co-operation and Development

OGD = Open Government Data

SDG = Sustainable Development Goals

SME = Small Medium-sized Enterprises

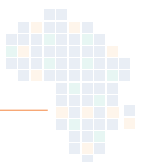
STEM = Science, Technology, Engineering and Mathematics

UAE = United Arab Emirates

UN = United Nations

VC = Venture Capital

WHO = World Health Organisation



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Kigali, Rwanda, 2021.



FOR AFRICA

BLUEPRINT

"AI For Africa" Blueprint

First Edition©2021

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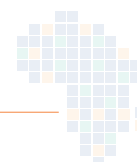
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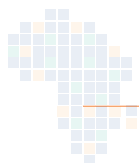
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GLOSSARY

Artificial Intelligence (AI)

Artificial Intelligence refers to any technology that enables machines to operate emulating human capabilities to sense, comprehend and act. Artificial intelligence (AI), is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals, which involves consciousness and emotionality.

Data Protection Principles (DPPs)

Data Protection Principles outline how data users should collect, handle and use personal data.

General Purpose Technology (GPT)

General Purpose Technologies (GPTs) are technologies that can affect an entire economy (usually at a national or global level). GPTs have the potential to drastically alter societies through their impact on pre-existing economic and social structures. Some examples are steam engine, electricity, computer internet.

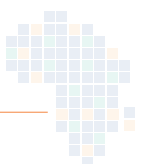
Machine Learning (ML)

"Machine learning is the field of study that gives computers the ability to learn without being explicitly programmed" (Arthur Samuel, 1959). In the past decade, machine learning has given us self-driving cars, practical speech recognition, effective weather forecasts, and a vastly improved understanding of the human genome. Machine learning is so pervasive today that you probably use it dozens of times a day without knowing it.

Soft Regulation

Soft regulation refers to a wide range of quasi-legal instruments that differ from hard law as they lack immediate, uniformly binding, direct effects, precision, and clearly delineated monitoring, dispute settlement, and enforcement authorities.¹ Such instruments include guidelines declarations and codes of practice.

¹ Shaffer G, Pollack MA (2009) *Hard vs. Soft Law: Alternatives, Complements and Antagonists in International Governance*. *Minnesota Law Review* 94, 706–799.



FOREWORD

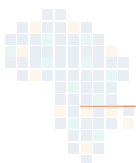


H.E. CYRIL RAMAPHOSA
PRESIDENT OF THE REPUBLIC OF
SOUTH AFRICA.

The world is on the cusp of digital revolution, and it comes with the opportunities and challenges. The approach taken largely by states, companies and related role-players requires a guide from continental and regional bodies.

The AU is a regional body designed to guide the prosperity at a continental level and as such is expected to play a significant role. The understanding is that time is not with us and urgent interventions are required.

One of the key digital technologies that drives digital revolution by countries is Artificial Intelligence (AI). The adoption of AI is based on the understanding that the AU has developed a continental plan known as Agenda 2063 which profess to take advantage of the youth bulge appeal.



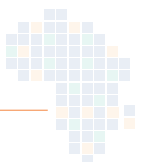
South Africa assumed the position of AU Chairperson for the year 2020 which comes because of member-states rotational basis. The theme for the 2020 Chairperson is "silencing the guns in the Continent". This theme is not just focused on stamping-out the internal wars and strife experienced in Africa but is also ensuring that digital revolution brings in the drive to keep our young and vulnerable at an innovation global levels and global competitiveness.

In accepting the AU Chairpersonship, I announced that an AI Forum must be established within the AU wherein the discussion and plans on AI would be addressed in uniformity. Artificial intelligence (AI) has reached a tipping turning point.

The power of AI starts with people and intelligent technologies working together within and across company boundaries to create better outcomes for customers and society.

But Africa is not fully prepared to seize the enormous opportunities that AI presents. The crafted AI Blueprint would set-up the African member-states towards developing policies, strategies and plans that would ensure growth and prosperity within the digital revolution space.

This AI Blueprint is a precursor for the African continent to become a global player within the digital technology state affairs and a huge contribution to positioning Africa within the 4th Industrial Revolution. There is a section within the AI Blueprint which guides the member-states on what they could or should implement around the matters requiring AI intervention as a technology of choice.



FOREWORD



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MR. LACINA KONÉ
DIRECTOR GENERAL, SMART
AFRICA SECRETARIAT

The international debate on the adoption and use of Artificial Intelligence (AI) has gained significant momentum in recent years and has intensified as countries seek to harness digital technologies to respond to socio-economic challenges. AI technologies can help promote inclusive economic growth, bring significant benefits to society, and empower individuals.

Currently, no African country is ranked among the top 10 countries expected to benefit most from A.I. and automation. In contrast to the leading A.I. nations such as China, the U.S. and others, African countries have been in general rather slow in the adoption of A.I. technologies. However, at Smart Africa, we believe that **Africa cannot and should not be left behind!**

It's no longer news that Artificial Intelligence (AI) will be a driving force behind the Fourth Industrial Revolution. The question is rather: how best to harness the potential of Artificial Intelligence in Africa?

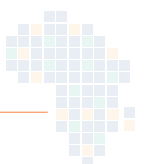
The responsible development and use of AI can be a driving force to help advance the African Union's Agenda 2063 and the Sustainable Development Goals (SDGs). The benefits brought by the responsible use of AI can improve the work environment and quality of life and create the potential for attaining a human-centred future society with opportunities for everyone, including women and girls as well as vulnerable groups.

This AI Blueprint is an endeavour born from the collaboration of the Republic of South Africa, whose championing the AI Flagship within the Smart Africa Alliance, the German Development Cooperation (GIZ) and the Smart Africa Secretariat working in tandem with stakeholders (member states, private sector, international organization, academia, and entrepreneurs) to guide in the following outcomes: (1) **help shape policies for strong and ethical A.I. across Africa**, (2) **foster A.I. expertise and solutions "made in Africa for Africa"**, (3) **create an enabling environment for open data to boost Africa-wide A.I. exchange, innovation and to create markets**, and (4) **secure investment to make A.I. ready for markets**.

Though this document will be a great milestone for Africa, **this is only the beginning**. There is a need for concrete solutions for the safe and ethical adoption and use of AI in Africa. The continent requires concrete projects that will push our continent to reach the 4th Industrial Revolution.

On behalf of the Secretariat, I would also like to acknowledge our partners: The Republic of South Africa, The Republic of Rwanda, the Republic of Uganda, the African Union, the International Telecommunication Union, the German Development Cooperation (GIZ), the World Bank, NEPAD, Intel, Microsoft, GSMA, IEEE, Syniverse, World Wide Web Foundation, UN Global Pulse, Carnegie Mellon University, and the Alliance4AI, for their willingness to share their insight towards the elaboration of our ambitious project of a continental blueprint on AI.

It is through partnerships from a cross-section of stakeholders such as these, that we will achieve great strides in our journey towards transforming Africa into a single digital market.



EXECUTIVE SUMMARY

Artificial Intelligence (AI) is a technology that can propel developing economies on a trajectory of sustainable development. This is however achievable only through the application of a coordinated, integrated approach to the development and implementation of AI strategies by Member States.

The African continent's intent is on leveraging the digital transformation process to achieve sustainable growth and development, as evidenced by the SMART AFRICA initiative. One of the main elements of this digitalization thrust relates to the application of AI technology. However, to date, a clear strategic and practical framework for the use and governance of such technologies, has not yet been articulated or documented. This AI Blueprint therefore lays the foundation for the development of an AI strategy and presents key elements and considerations to be borne in mind for the formulation of such.

The overall objectives of the blueprint are:

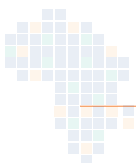
- ✓ to outline the most relevant opportunities and challenges of the development and use of AI for Africa and how to address them.
- ✓ to make concrete policy recommendations to harness the potential and mitigate the risk of AI in African countries.

Against this background, Smart Africa created an AI working group with experts from Member States, the private sector, international organisations, academia and entrepreneurs, for guiding the development of an AI blueprint for Africa. The Republic of South Africa, one of the Smart Africa Member States, has committed to champion the development of this blueprint as part of their flagship project "4th Industrial Revolution: innovation and artificial intelligence" within the Alliance.

AI refers to general-purpose technology

As presented in Chapter 1, AI refers to general-purpose technology. Like other general-purpose technologies did in the past (e.g., the steam engine or electricity), AI is transforming our world, our society, and our industry.

Such advancements have become possible due to the concept of machine learning. As a result of this development, there is great versatility in the application of AI and as such, fields of medicine, agriculture and meteorology have all benefitted.



More developed economies like the United States of America, the European Union and China are at the forefront of the development and implementation of AI policies and strategies. Africa has recently commenced its journey in respect of leveraging AI and is well positioned to develop a coordinated strategic approach to the use of AI at the national and regional levels.

Lessons learnt on AI governance and strategies

As intimated in Chapter 2, Africa can leverage lessons learnt from the experiences of other countries which have undergone the development and implementation of AI strategies. This AI Blueprint therefore proposes the application of 6 key principles to the development of an African AI Strategy, notably:

- ✓ The inclusion of AI as part of a wider national strategy
- ✓ Balancing the development of an AI enabling environment against ethical, legal and governance considerations
- ✓ Underscoring the importance of both the process and the plan
- ✓ Focusing on action
- ✓ The application of an inclusive approach to AI- by the people, for the people
- ✓ Leveraging the national AI strategy as a tool for communication

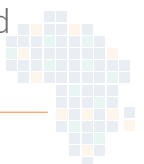
Chapter 2 further explains and concludes that flexibility should represent a core pillar in the African AI strategy, particularly in respect of governance, given the innate fluidity of AI technology. The strategic governance framework should be sufficiently malleable to allow for the implementation of both proactive and timely responsive measures to cater for developments in AI technologies.

Based on the premise that an all-inclusive approach should be taken to the development of an AI strategy, Chapter 3 explores the framework for national AI strategies in Africa. It discusses and highlights the relevance of the 5 pillars of an AI national framework.

AI strategic framework for Africa

These pillars are noted to be:

- ✓ Human capital, which underscores the importance of educational development in respect of AI. This pillar addresses the relevance of enhancing the proficiencies, competencies and understanding of individuals in respect of using and developing artificial intelligence solutions.



- ✓ From Lab to Market initiatives that foster research, development, innovation, and commercialisation.
- ✓ Networking, cooperation and collaboration, in pursuit of joint partnerships across private and/or public sectors in an effort to favourably impact the uptake of AI.
- ✓ Fostering the development of digital and telecommunication infrastructure to pursue efficient data collection and usage.
- ✓ Effective regulation that is premised on the infusion of ethics and international best practices.

Governance and Ethics for AI

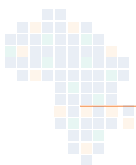
Chapter 4 presents an analysis of governance and ethics within the context of regulating AI. In emphasizing the importance of digital governance, this chapter compares various regulatory approaches. The analysis identifies that an adequate legal framework must consider AI applications, data, ethics, the establishment and operationalisation of an enabling business environment, the multiplicity of regimes and industries which must be catered to and the application of soft law or hard regulation, as applicable. The use of hard regulations is advocated in situations where soft law or the marketplace itself, cannot resolve market concerns. The application of hard law is most applicable in instances that interplay with:

- ✓ The regulation of copyright/patents
- ✓ The promotion of investment, protection of intellectual property and regulation of accountability systems
- ✓ Unfair competition laws or other similar regimes

Soft regulation is noted to establish expectations that are not enforceable by government and includes instruments such as professional guidelines, codes of conduct/codes of ethics and international best practices.

Chapter 5 discusses the practical use and application of AI to real-life, noting key sectors which can potentially benefit from the leveraging of this general-purpose technology.

AI to real-life – concrete use cases



Key sectors and areas of focus discussed are agriculture, education, health, financial services, energy, transportation, and climate change. This Blueprint proffers that a clear roadmap is required to ensure that real benefits are derived from the application of AI technology.

Accordingly, Chapter 6 sets forth a roadmap for Africa in this regard. The roadmap proposes to include:

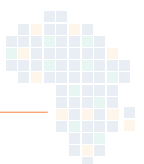
- ✓ Collaboration in the formulation of policies, ensuring that there is harmonization, inclusivity and international best practices infused therein. To achieve this, it is proposed that a coordination mechanism for AI policy at regional level is established and similarly, peer to peer exchanges and benchmarking mechanisms are to be instituted.
- ✓ Creation of an open data environment for Africa, leveraging the lessons learnt from other initiatives (e.g. the European Commission). This element advocates for the establishment of AI-ready data as a public asset and the normalizing of the concept of open public sector data to reduce entry barriers and promote AI innovation.
- ✓ Common Computing Infrastructure to host, process and use data, thus cultivating a culture to foster the development of data lakes, enabling data analytics and machine learning.

Data is a critical AI asset

Data is a critical asset for developing AI. In this blueprint we cover several aspects in detail, from how to accelerate the availability of data assets by leveraging the usage of non-traditional data or facilitating sharing data from public to private, and how to define data strategies to cover the regulatory aspects in data privacy and accessibility. In the end we extend our considerations to a wider regional approach in sharing data and infrastructures.

Chapter 7 summarises a list of recommendations, which take into account the potential of lessons learnt from several countries for the development and use of AI for sustainable development, sector priorities for AI in the African continent and the landscape of use cases analysed in chapter 5.

In conclusion, AI presents unique opportunities for the African continent. In countries with high uptake, AI has proven to improve service delivery, efficiency and effectiveness both in the public and private sectors.





1 AI SYSTEMS: A GENERAL-PURPOSE TECHNOLOGY

"AI For Africa" Blueprint

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AI Systems: A General-Purpose Technology

1.1. AI in brief

History tells a story of technologies which are destined to transform the world. Artificial Intelligence (AI) represents such a technology which has already spurred immense

AI is a general-purpose technology that can improve the lives of everyone.

change. This is evident in the use of computers and phones when we translate texts online or generate directions from our current locations to our intended destinations.

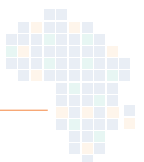
AI is a General-Purpose Technology that can improve the lives of everyone. General-Purpose Technologies (GPTs) are technologies that can affect an entire economy (usually at a national or global level). GPTs have the potential to drastically alter societies through their impact on pre-existing economic and social structures. Some examples are steam engine, electricity, computer, or the internet.

Beyond making our lives easier, AI has the potential to solve some of the world's biggest challenges, which have previously been regarded as difficult to solve (from treating diseases and discovering new drugs, to optimizing agriculture and safeguarding food security, to fighting climate change and predicting climate variability).

We already have AI solutions to identify or predict diseases and pests in crops even from satellite images. The first trial of an AI-discovered drug is in progress, and there is an entire movement around using AI to tackle climate change issues.

Like other general-purpose technologies did in the past, AI is transforming our world, our society, and our industry. AI is composed of several disciplines (e.g., machine learning, cognitive computing), is already applied as a service (e.g., Siri or the Google assistant or applied computer vision) or Graphs (like the one in LinkedIn or Facebook to understand social connection), and all utilize and leverage data accessibility to create solutions. The drive for digitalization largely contributes to the creation of high-quality data; this is a key enabler for the development of Artificial intelligence.

The field of "Responsible AI" or "Ethically Aligned Design practices" includes a growing body of organizations including the EU, OECD and IEEE Standards Association which prioritize responsible AI and innovation practices at the outset of design. The logic is to apply methodologies incorporating end user values along with socio-technical considerations.



1.2. AI and Machine Learning

Artificial Intelligence refers to any technology that enables machines to operate emulating human capabilities to sense, comprehend and act. IEEE taxonomy recommends avoiding anthropomorphic language that would infer the AI can in fact "learn" which is generally attributed as a human trait versus using technical terms like, "improve in functionality". In recent times, we are observing three trends which make AI possible :

- ✓ First, one technological, tied to the wide availability of notable amounts of data that could be analysed with the cheap computing power available.
- ✓ Second, one economical, with a progressive investment of stock markets and venture capital in technological companies and technological start-ups.
- ✓ Third, one cultural, where most of the world population is becoming more and more digitally enabled.

Machine learning (ML) is the science of getting computers to act without being explicitly programmed. In the past decade, machine learning has given us self-driving cars, practical speech recognition, effective weather forecasts, and a vastly improved understanding of the human genome. Machine learning is so pervasive today that you probably use it dozens of times a day without knowing it.

1.3. AI impact and opportunities

AI is recognised for its projected economic impact:

According to a recent study on the long-term economic impact of AI around the world, AI has the potential to double a country's GDP growth rate by 2035⁶

AI is seen as **a new factor of production** that advances growth in at least three important ways:

- ✓ Productivity gains from businesses automating processes (including use of robots and autonomous vehicles).
- ✓ Productivity gains from businesses empowering their existing labour force with AI technologies (assisted and augmented intelligence).
- ✓ Increased consumer demand resulting from the availability of personalised and/or higher-quality AI-enhanced products and services.

In Africa, governments recognise the central role that AI can play in the new industrial revolution. While there are AI use cases for all sectors of the economy and society, the Smart Africa AI Working Group identified priority sectors where AI adoption has the potential to impact the continent the most:

- ✓ **Agriculture** will be more efficient and effective, with increased yields and reduction in poverty.

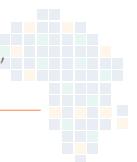
- ✓ **Education systems** will become more accessible, efficient, and personalized, allowing improved access and active participation.
- ✓ **Healthcare** will be better tailored, have a higher, standardized quality, and become more accessible, while improving outcomes.
- ✓ **Financial services** will be more secure and reach more citizens who need them, expanding access and facilitating development.
- ✓ **Energy and Transportation** will become more efficient and distributed, with greater development in the use of renewable energy, and more efficient transportation with a lower carbon footprint.
- ✓ AI adoption could facilitate the delivery of **governmental services** to citizens, unlocking the value of data to simplify and accelerate predictive and prescriptive processes, allowing governments and agencies in the region to drive better services and decision making. An AI-developed economy will also generate a significant number of **high-value jobs** correlated to AI solutions: from network engineers to programmers, to robotic experts. These jobs will require specific skills and competencies and afford the opportunity to attract international investments, both capital and industrial in an effort to address any shortages in the market in this regard.

1.4. AI and SDGs

Artificial intelligence can be used to address several pressing issues for governments and societies such as improving public service delivery, increasing economic growth, and addressing a variety of sustainable development targets. Due to its various use-cases across sectors, AI has the potential to make a substantial contribution to the achievement of Africa's 2063 vision and of several of the SDGs⁷.

The study finds that AI can support the achievement of 128 targets across all SDGs, but it may also inhibit 58 targets. Notably, AI enables new technologies that improve efficiency and productivity, but it may also lead to increased inequalities among and within countries. The fast development of AI needs to be supported by appropriate policy and regulation. Otherwise, it would lead to gaps in transparency, accountability, safety and ethical standards of AI-based technology, which could be detrimental towards the development and sustainable use of AI. Finally, there is a lack of research assessing the medium and long-term impacts of AI. It is therefore essential to reinforce the global debate regarding the use of AI and to develop the necessary regulatory insight and oversight for AI-based technologies.

⁷ Vinuesa, R. et al (2019) The role of artificial intelligence in achieving the Sustainable Development Goals, online: <https://arxiv.org/ftp/arxiv/papers/1905/1905.00501.pdf> [accessed Feb 24, 2020].



A strong African AI industry, AI research community and AI civil society are of key importance to ensure that solutions are locally adapted and locally sustained.⁸

AI for Development (AI4Dev) is a challenge, organised by ITU, that aims to identify great ideas in Artificial Intelligence (AI) and utilize its impact on four Sustainable Development Goals (SDGs) in the Arab & African states.

1.5. Challenges

As of now, the USA, China and the European countries are leading the development of AI. Consequently, they are likely to reap most of the economic benefits and dominate policy debates. This creates an overarching challenge that African countries are left out of the development, application and regulation of artificial intelligence. In order to formulate a successful strategy to counter this risk, it is useful to take stock of the existing challenges and opportunities Smart Africa and its member states are currently facing.

Access to AI Data and Cloud Computing technologies

Modern AI consumes data, and the higher the quality and the variety the better will be the performance of algorithms. An example of this could be an AI tool to automate radiological diagnosis: it improves functionality from a vast amount of X rays with specific annotations from radiologists. If those annotations, or the quality of the images will be low, then the performances of the algorithm will be limited. The comparatively low digitalization in Africa leads to a lack of digital data to effectively train AI. Also, to successfully address local problems there is a need for local data. Language, expenditure, and agricultural data need to be localised to produce solutions that effectively address local challenges. In addition, AI requires a number of technologies and services (e.g. data storage and processing services) that could be expensive to build, purchase and/or import.

Technical know-how

Patents and scientific publications on AI are coming mainly from the US, China, Canada, Europe, Japan. Africa is still far behind and this limits the innovation opportunities in the field. Progress on AI is largely driven by specialists in computer science and related fields, however there are still too few universities, coding schools and research centres able to train and educate young professionals and train researchers. STEM subjects in primary and secondary education are not systematically taught and this leads to a fundamental educational gap which is difficult to address at a later stage with the skills necessary for AI professions.

Governance and regulatory challenges

Many issues in AI are still at a nascent stage of discussion and as such it is important for Africa to be part of the dialogue at the international level. Key to the discourse should be

⁸ <https://www.ai4dev2020.com>

the scope of the ethical framework to be developed, whether Africa-wide or otherwise. There are also lessons to be learnt from the US and the EU, and Africa must take note to learn from the mistakes of others and build on their successes.

Country specific challenges

Next to the overall challenges, countries face specific issues. For example, some countries need to develop proper infrastructure to support a substantial expansion in the use and development of AI. The stability of the power grid, higher levels of rural electrification and developed ICT infrastructure can all contribute to faster AI-based growth. Nigeria and Kenya, for instance, are both nascent AI countries but score relatively low in the Global AI index due to the low electricity access⁹.

Other countries like in the case of South Africa¹⁰, voiced the concern that automation will replace jobs or that there is little public participation in shaping the new technology.

1.6. Why an AI strategy?

Industrial output is generally dominated by larger economies, but AI follows a different model. Even smaller countries will have a place on the world map (e.g. Singapore). AI offers the opportunity to compete on a global scale.

If a country does not have domestic AI infrastructure, domestic AI capabilities, and a domestic ecosystem, the country will be less relevant in the global AI landscape. For this reason, AI is an opportunity that requires public leadership and a national AI strategy is an essential step to define the vision and the course of action.

Many countries have already released or are planning to release national AI strategies soon. Africa is a continent still vastly uncovered by this process¹¹. The map below provides a picture as of January 2020, however since then several African countries have initiated AI strategies (e.g. Mauritius, Nigeria, Egypt, Rwanda, Ghana, South Africa).

9 Tortoise Global AI index

10 Source: Presentation by Dr. Rachel Adams, Chair of South Africa's National Expert Advisory Group on developing a national AI strategy, at the Country X's National Expert Task Force on Fourth Industrial Revolution Technologies

11 <https://oecd-opsi.org/projects/ai/strategies/>

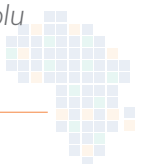
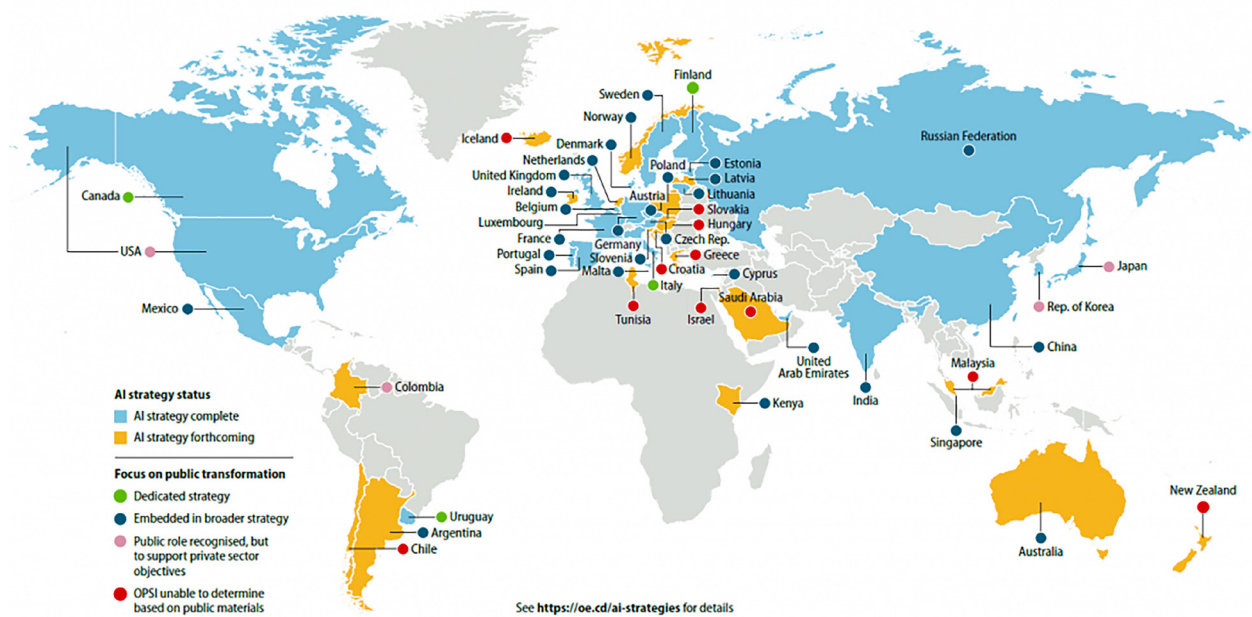


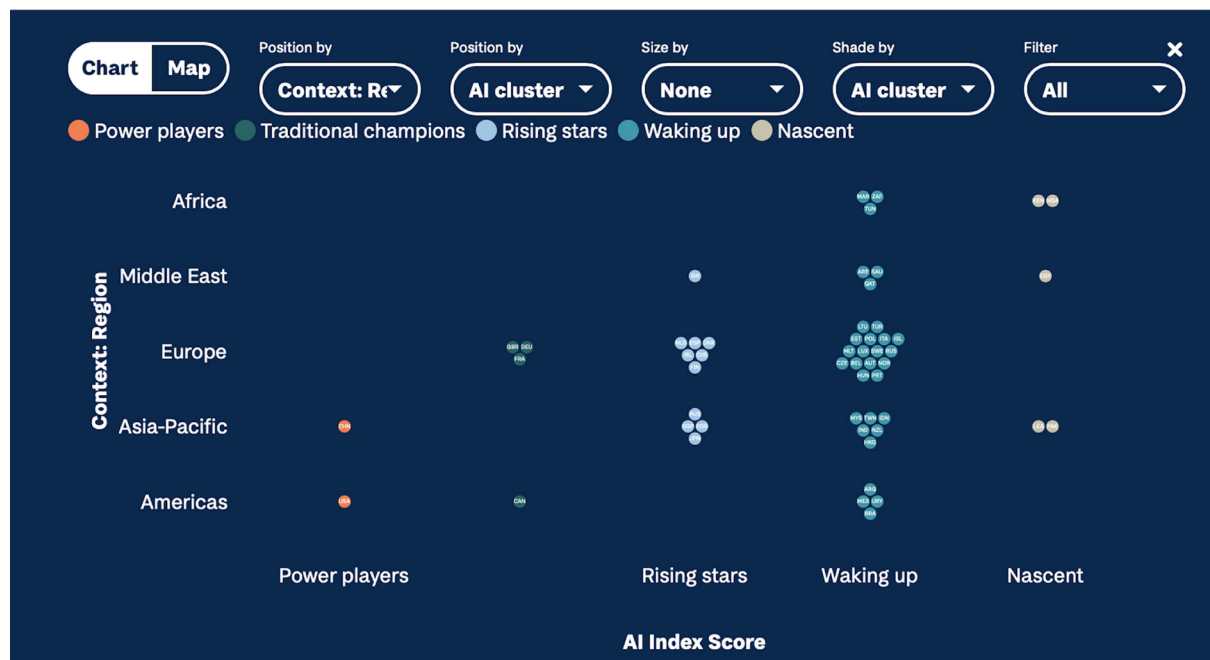
Fig. 1 AI Global Landscape



Source: 2020, OECD AI Global Landscape

A similar overview is provided by the Global AI Index.¹² The Index is calculated for 62 countries including clustered power players, traditional champions, rising stars and nascent entrants. According to the index African countries such as Tunisia, South Africa, Morocco, Egypt, Kenya, Nigeria are in the "waking up" or "nascent" clusters. The index takes into account several levers such as talent infrastructure, operating environment, research, development, government strategy, and commercial capacity.

Fig.2 Global AI Index- Positioned by AI Clusters and regions



Source: 2020, Tortoise media. Position, size and compare countries based on their results on The Global AI Index.

¹² <https://www.tortoisemedia.com/intelligence/global-ai/>

1.7. African countries' interest towards AI

Various other countries in Africa have initiated the process of developing human rights and ethics-based national AI strategies. Mauritius is one of the first countries in Africa that has adopted a national AI strategy, with six other countries at various stages in the process. These other countries have established a variety of bodies to develop their AI strategies, including Egypt's National Council for Artificial Intelligence, Kenya's Distributed Ledgers Technology and Artificial Intelligence Taskforce, South Africa's National Expert Advisory Group, Tunisia's Task Force and Steering Committee and Uganda's National Expert Task Force. Additionally, the South African Presidential Commission on the Fourth Industrial Revolution's (PC4IR) Report – which provides extensive articulation of leveraging the digital transformation process (including development and application of Artificial Intelligence) to achieve sustainable growth and development. The PC4IR report puts forward the premise of a "human-centric" approach. Ghana has partnered with UN Global Pulse to conduct a mapping of Ghana's AI ecosystem and to complete a blueprint for its national AI strategy. Rwanda has initiated a multi-stakeholder process to develop a national AI policy with a specific focus on the ethical use of AI and to promote social and economic development. The African Union Working Group on Artificial Intelligence is also developing a unified continental strategy and vision on AI. The Tunisia start up act is a good example of how to incentivize the creation of AI Champions. Members of the local start-up scene played a key role in drafting the new legislation in what's being praised as an example of "bottom-up policymaking".

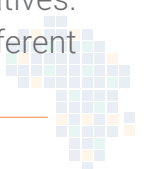
1.8. Why a blueprint?

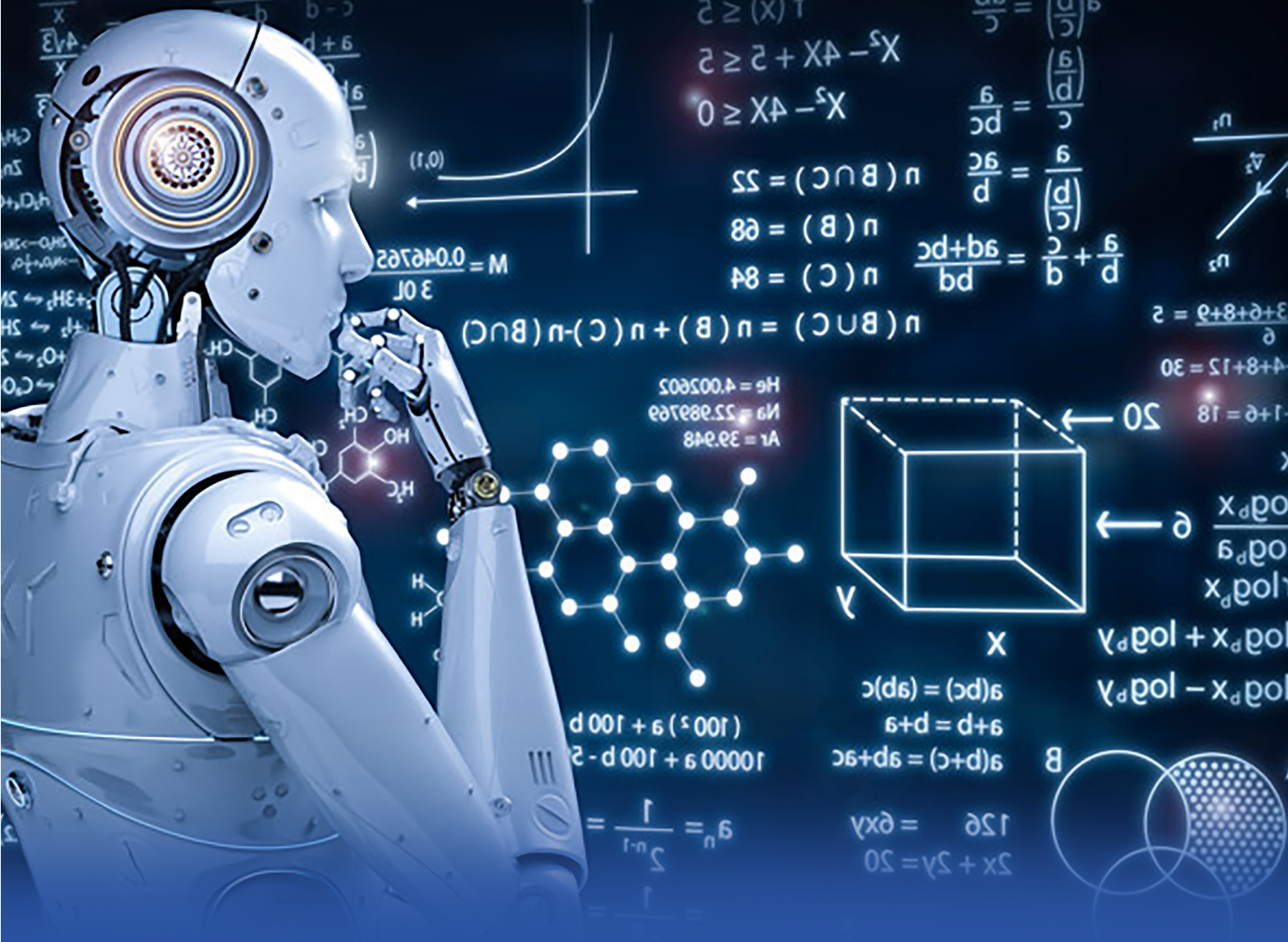
Successful global cooperation is best achieved from a common African position on AI while guaranteeing African AI sovereignty. This calls for regional coordination of AI strategies, economic initiatives and policies. Moving forward together and encouraging mutual learning among African governments, regulators and societies promises to increase efficiency and leverage each partner's strengths in the regional development of AI.

Against this background, Smart Africa leads an AI working group with experts from member States, the private sector, international organisations, donors, academia and entrepreneurs, for an AI blueprint for Africa. The Republic of South Africa, one of the Smart Africa member states, has committed to champion the development of this blueprint as part of their flagship project "4th Industrial Revolution: innovation and artificial intelligence" within the alliance.

1.9. How to use this blueprint?

Chapter 2 provides lessons learnt and actionable recommendations for African Member States for adoption of an AI national strategy. Chapter 3 provides a framework to implement a national AI strategy based on five pillars (human capital, from lab to market, networking, infrastructure, regulations). Chapter 4 presents guidance for governments to address governance and Ethics in relation to AI. Chapter 5 is a collection of sector use cases where AI can impact the most in Africa. Chapter 6 is a series of actionable recommendations for regional and continental AI initiatives. Chapter 7 is a collection of conclusions and/or recommendations from the different previous chapters.





2 LESSONS LEARNT FOR SUCCESSFUL AI STRATEGIES

"AI For Africa" Blueprint
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Lessons learnt for Successful AI Strategies

In this chapter we illustrate lessons learnt from various countries to implement a successful AI national strategy.

2.1. AI is part of a long-term wider strategy

Adoption of AI requires investment in people (expertise, training), technology (storage and specialist tools) and change (product development, going digital, making innovation operational). This can be a barrier to adoption if there isn't a clear long-term benefit for each stakeholder and a way of funding the investment necessary to deliver it sustainably. The first thing a government has to ask is what the problems are and how it can be solved with AI. Not all countries have the same drivers. In **Denmark**, for example, there is short supply of workers in several areas. They need to use AI and automate some of the jobs, so that the population will benefit. **India's** national strategy focuses on the impact AI has on the economy. It supports SMEs and Micro enterprises offering AI solutions for vertical national priorities (e.g. healthcare, agriculture). In **Mauritius**, AI addresses not only the economic, social and financial issues, but it is promoted as an important vector of revival of the traditional sectors of the economy.

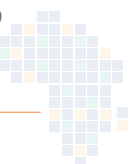
2.2. Balance between enabling environment and governance

Kenya's AI strategy cites that while directly regulating the technology, the government should consider innovative approaches, such as regulatory sandboxes that can test methods by which the needs of both the public and private sectors can be balanced. While regulating the effect of technology, the government should consider a collaborative cross-industry partnership between the public and private sectors and with global partners to effectively identify potential issues and implement the best-in-class policies.

Another issue is striking a balance between creating an enabling environment which supports innovation while mitigating the risks of AI and safeguarding fundamental human rights; this essentially seeks to ensure that AI does not harm people. In this respect, **Singapore**, one of the most advanced countries in the world in terms of AI, chose the option to have a national AI strategy separated from private sector regulation. The Model Artificial Intelligence Governance Framework was introduced in 2019 as a guide for organizations to practically address key ethical and governance issues when deploying AI technologies, with the intention of striking a balance between regulation and innovation. The framework quickly became a world class model for internal governance structures and measures, human involvement in AI-augmented decision-making, operations management and stakeholder interaction and communication. This bold choice is intended to build stakeholder confidence in AI through organisations' responsible use of AI to manage different risks in AI deployment.

2.3. The process can be as important as the plan

Engaging the stakeholders of the AI ecosystem, for example, is essential to implement the strategy. For example, in **Canada** thanks to its National Strategy, AI centres across



the country have evolved into a coordinated and flourishing ecosystem. The ecosystem serves to translate AI research discoveries into applications for use in both the public and private sectors. The strategy was launched at the right time to generate momentum. Progress in AI via the strategy enriches many areas of the country. For example, it creates economic benefits through the commercialization and adoption of AI. It drives advances in knowledge and R&D and contributes to job creation. It attracts new international talents and develops local talents through education. Lastly, it improves society by promoting AI for Good and Responsible AI initiatives.

2.4. National AI Strategies focused on action

In the dynamic world in which we live, a strategy is never completed; it needs to be revisited, updated and revised. Citizens will see little impact without concrete actions. The boldest statement comes probably from **China's** AI strategy. China announced its ambition to lead the world in AI in its July 2017 development plan, A Next Generation Artificial Intelligence. The plan is probably one of the most comprehensive of all national AI strategies, with initiatives and goals for R&D, industrialization, talent development, education and skills acquisition, standard setting and regulations, ethical norms, security, and playing an international role on AI. In Africa, the **Kenyan** AI strategy implementation plan includes actionable initiatives to create an adequate ecosystem¹³ (e.g. creating a Data Sharing Framework; enable citizens to store official documents in the cloud; connectivity to all government institutions, offices, schools, hospitals, by broadband services such as 3G/4G/5G, and/or various fixed broadband services; authentication of individuals using a Digital ID).

2.5. AI is made by the people for the people

Over the past few years, AI has matured considerably and is becoming the driver of digitalisation and autonomous systems in all areas of our life. Recognising this, **Germany's** national AI strategy aims to become a leading centre for AI and thus helps to safeguard Germany's competitiveness in the future. At the same time, Germany seeks to encourage responsible development and use of AI which serves the good of society. They plan to integrate AI into society in ethical, legal, cultural and institutional terms in the context of a broader societal dialogue and active political measures.

2.6. Leveraging the national AI strategy as a tool for communication

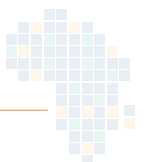
An AI strategy is a message to the leaders, citizens, and to the world. The key communication message underpinning the strategy is "we understand the importance of AI to the world and we have a plan".

For example, the **UAE** has an AI strategy with the objective of investing in the latest AI technologies and tools to enhance government performance and efficiency. The strategy is implemented by BRAIN (Building a Responsible AI Nation), the UAE National Program for Artificial Intelligence. BRAIN is a comprehensive plan that highlights the

¹³ Distributed Ledgers Technology and Artificial Intelligence Task Force of Kenya. (2019). *Emerging Digital Technologies for Kenya: Exploration & Analysis*. Retrieved from <https://www.ict.go.ke/blockchain.pdf>

advances in AI and Robotics to chart a path to position the UAE globally as a leading participant in the responsible use of AI and its tools. This program is a good example of how to communicate various initiatives, collaborations, partnerships and breakthroughs in the field of AI, and the impact of all these on humankind.

It is also important to enhance public awareness of the issues presented by emerging technologies through consultations, awareness campaigns about the benefits and harms of the use and non-use of data and AI in areas of national importance.





3 GUIDELINES TO DESIGN AI NATIONAL STRATEGIES IN AFRICA

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Guidelines to design AI national strategies in Africa

The goal of most national and regional AI strategies to date is to become the global leader in AI research and deployment. As a response, a smart African strategy is needed to find a profitable niche in this global environment of fierce competition. A focus of intra-African, home-grown AI-development is a promising way forward. Local AI avoids dependencies from international platform monopolies in the field of data provision, data processing and AI solutions.

AI for Africa by Africa.

An overarching policy goal should seek global AI cooperation while guaranteeing a certain level of AI-independence with regard to crucial policy areas. A vision of an AI made for Africa by Africa.

The African Union affirmed the role of digital technologies and innovation in the achievement of the vision and goals of the African Union's Agenda 2063 and the UN Sustainable Development Goals. The African Digital Transformation Strategy (DTS) and the African Union Communication and Advocacy Strategy (CAS) are among major AU initiatives in final declaration.

This chapter provides principles and practical guidelines for African governments to shape or initiate their national AI strategies.

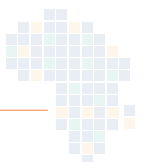
3.1. Various frameworks and AI global indexes

There are several initiatives aiming to develop AI national Frameworks. For example, the **Global Partnership of Artificial Intelligence (GPAI)** provides suggestions for data governance frameworks. GPAI also provides a catalogue of existing key initiatives on responsible AI. The **OECD** sets out a series of internationally agreed principles and recommendations that can be used as guidelines by governments. The **European Commission** published a white paper on AI called "European Approach to excellence and Trust". The White Paper provides the foundations for national AI strategies. There are several **AI readiness indexes**. They map how governments position themselves in relation to AI. For example, Oxford Insights published the AI readiness Index 2020¹⁴ and Tortoise The Global AI Index¹⁵ Another relevant initiative is the World Economic Forum's Framework for Developing a National Artificial Intelligence Strategy¹⁶ This is a framework that lays out for nations who have yet to develop an AI strategy, how to best get to a minimum viable solution.

14 <https://www.oxfordinsights.com/government-ai-readiness-index-2020>

15 <https://www.tortoisemedia.com/intelligence/global-ai/>

16 <https://www.weforum.org/whitepapers/a-framework-for-developing-a-national-artificial-intelligence-strategy>



Although not an index, it is, also, worth mentioning the research initiative AI ethics for Africa coordinated by the Human Sciences Research Council (HSRC) of South Africa¹⁷.

It consists in the production of papers from academic institutions, think tanks, and research organizations registered and operational across Africa.

3.2. 5 Pillars for AI strategies

Considering the diversity of development pathways in Africa, it is not advisable to propose one AI policy solution working for all. These guidelines can be used by African states to develop and implement their own national AI policies. In this chapter we illustrate the 5 important areas that a national AI strategy should address:

- ✓ Human capital
- ✓ From lab to market
- ✓ Networking
- ✓ Infrastructure
- ✓ Regulation

This chapter explores in detail the 5 areas in the context of Africa.

3.3. Human capital

The size of this transformation, with growing investments and demand is creating a huge skills gap across the world.

According to the World Economic Forum (WEF), in their Future of Jobs reports, AI will create much more jobs than it destroys – by 2022. 75 million jobs are expected to be displaced by automation; 133 million new ones will emerge. Nonetheless, if we don't take the right steps to educate and (re)train the workforce in Africa there will be a serious shortage of talent with the necessary AI skills to fill the new jobs that are created.

The current pandemic situation is accelerating the digitalization of the economy and is contributing to accelerate both the demand for AI skills and the job displacement, while the actual number of AI experts around the world today remains alarmingly small.

The opportunity offered by this large and rising skills demand, combined with the availability of a potential young talent pool in Africa and of Africans abroad (the diaspora), and the opportunity to develop solutions made in Africa for Africa, could lead to a flow of investments and collaboration in the continent and contribute positively to the socio-economic development of the region.

¹⁷ <http://www.hsrc.ac.za/en/departments/impact-centre/ethics-ai-africa>

What is needed for AI development?

The development of AI skills needs to start from basic education, building a solid background with foundational skills. Reviewing the curricula in the education system, starting from primary schools (e.g., introducing basic coding, foundational mathematics, logical & critical thinking, and utilization of basic open source or robotics), could increase the skills necessary for future study of AI. Universities need to have more AI specific paths and create multi-disciplinary courses for AI in collateral domains like agriculture, healthcare or economy. AI research across Africa should also be encouraged by establishing a network of African AI centres of excellence.

A network of African AI centres of excellence

These centres should focus on the applications of AI to local problems and contexts as well as policy advice to governments. These centres should also focus on multi-stakeholder involvement of top researchers, policy makers, civil society and industry partners to develop pan-African excellence in AI. Partnerships with the private sector will allow targeted research and work to solve practical problem thus shaping the curricula. Solid investments in facilities and spending for research to facilitate the consolidation of researchers and professors will also be key in a world which is pushing for the outflow of expert talent in AI.

Implement AI skills initiatives

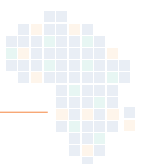
There are already many excellent African research and education institutions. For example, the African Institute for Mathematical Sciences (AIMS) and the Centre for Artificial Intelligence Research (CAIR), in addition to several universities like the University of Johannesburg which already have programs dedicated to AI. There is a need to build on such initiatives to capacitate a group of highly skilled African AI experts. In addition to building high-level AI expertise, governments should develop programs to broadly inspire youth on AI, and

Incentivizing skill transfer initiatives

in parallel upskill and reskill large numbers of young people across the continent to take up jobs in the field of AI and emerging technologies. In this process, governments should encourage public private partnership models for job readiness in the field of AI and cutting-edge technologies by offering industry-oriented curricula, training, internships and project opportunities across K12 and technical/vocational education systems. Widely available and resource-efficient formats, such as e-learning, can be used to reach large numbers of people.

Facilitating other open, grassroot initiatives like Data Science Africa¹⁸, could also contribute to generating a culture and creating inspirations and champions.

¹⁸ <http://www.datascienceafrica.org/>



Given, the growing importance of AI for economic development, AI skills initiatives should create opportunities for addressing issues of social and gender inequalities, in particular leveraging and promoting the talent and know-how of women.

Skill and knowledge transfer

In this scenario where a large number of skills need to be created in a short time, on-the-job skills transfer could contribute, especially for collateral jobs which are needed to deliver, maintain, operate and integrate AI solutions in complex scenarios.

Incentivizing these practices for companies could help lower the cost of skills transfer initiatives and facilitate re/up-skilling of workers, developing a more solid workforce to operate in the field.

3.4. From lab to market

In contrast to the leading AI nations, African countries have been rather slow in the adoption of AI technologies. As a result of the slower adoption rate, according to recent statistics, the US sees a higher volume of VC investments in one morning (\$155 million) than the Southern Africa region records in one year (\$77 million in 2017) .

AI start-ups can attract VC investments

VC funding raised by African tech start-ups in 2019 totalled \$2.02 billion, compared to \$1.163 billion in 2018, representing a 74% growth¹⁹.

Although Africa's AI industry is still nascent compared to the USA, Europe and Asia, this hasn't stopped some of the continent's most innovative start-ups from developing solutions that prove how promising the technology can be for Africa's economy. Multiple African countries have a fledgling AI start up scene and pan African community driven events such as AI Expo Africa / Deep Learning Indaba are now well established and helping grow the AI community across the region. The figure below provides a landscape of over 75 AI ventures in Africa.

¹⁹ Partech Africa Team (2020) 2019 Africa Tech Venture Capital Report, online: https://partechpartners.com/documents/12/2020.01_Partech_Africa_-_2019_Africa_Tech_VC_Report_FINAL.pdf [accessed Feb 26, 2020].

ADOPTING ARTIFICIAL INTELLIGENCE IN AFRICA

75+
VENTURES USE ARTIFICIAL INTELLIGENCE

#INNOVATIONMAPS

- 5+ STARTUPS
- 2-4 STARTUPS
- 1 STARTUP
- NO STARTUPS IDENTIFIED

TUNISIA

InstaDeep™ C@GNIRA
Incept
Wibau
SEWELIX
despernak
Babalu
chico
Kodinos

Egypt

Batme elves WideBOT
DevisionX
Omnivision

MOROCCO

ATLAN Space*

GHANA

Google AI
aidah
KudiGO

Senegal

Boamtu

Nigeria

TouchBot
DeepQuest AI
CHINKI
plantvius
tuteria
jiji
ajala
RxAll
Vavetsark
Ubenwa
ONEFI
Share Suite
PDSN

Zambia

SOUTH AFRICA

BETHALE
Droptek
LABI
Aerobolics
Prophet
vizibini
gicrefix
instabot
IXIO
ecocystema
CATORA
synergislife
datagripnet
Aturidi
intelleo
cluvva
VOA
GOTBOT
vinCharbot

Madagascar

TELLER

Tanzania

parrOt.ai

Zimbabwe

CLOUDIMATE

Kenya

SUPERFLUID
cellulant
utuhouse
IBM
MACHINA HEALTH

Ethiopia

UGANDA

awamo
Geo Gecko

Rwanda

ZINDI
AI EXPO
AI EXPO KENYA
AI EXPO RWANDA

INCLUDED

DATA AND ANALYTICS
Organizations that build smart analytics products
22

BOTS, CHATBOTS, AND VIRTUAL ASSISTANTS
Organizations that focus from facing technologies such as bots and chat assistants
16

VISION
Organizations that build AI-enabled vision systems such as smart cameras
16

LANGUAGE OR TEXT RECOGNITION
Organizations that develop smart systems powered by AI
7

HUB OR AI CENTRES
Organizations that support startups building AI-powered products or services
7

HEALTH AND DIAGNOSTICS
Organizations that provide AI-based healthcare services
6

PROFESSIONAL SERVICES AND AI DEVS
Organizations that provide AI support and white label solutions
6

ROBOTICS
Organizations that build robots and other AI-enabled machines
4

NOT INCLUDED

DRONES
Organizations that build or provide drone services only.

A collaboration with Alliance*+*AI

Focusing more narrowly on AI, some venture capital firms have taken a bet on AI start-ups on the continent²⁰ Supporting **AI start-ups** to excel is key to attracting more investments to Africa.

African countries should develop public-private AI initiatives to reinforce collaboration between academia and industry. To further encourage spin-offs from AI research and test their market-readiness, African AI business incubators and accelerators should be created and work closely with leading universities. Moreover, funding schemes can support more target-oriented research projects between academia and industry. Projects should be in line with a common research agenda deliberated in a multi-stakeholder process.

There is a need to take AI out of research lab or pilot projects and accelerate the development of solutions which are ready for the market and could be adopted. To accelerate the speed of the adoption curve, as well as to facilitate the creation of an AI culture, a vibrant AI ecosystem is needed.

The innovation pipeline

In an ecosystem, the innovation pipeline is fundamental, and data, especially locally produced data, is the foundation to build the system on. The rest of the ecosystem is made by public and private bodies, business incubators and accelerators, research centres, communities and professionals. Investments in all those areas will develop the ecosystem, facilitating awareness and connections between all its actors.

Additionally, the improved awareness and visibility offered by ecosystems will spotlight AI Champions in countries with different maturity and pace in adopting digital technology and AI.

A vibrant ecosystem will facilitate the consolidation of grass-root initiatives in AI, by structuring them in streams and allowing them to scale-up towards a more consistent positive impact to the socio-economic development.

3.5. Infrastructure

The production and deployment of AI necessitates the application and utilisation of advanced infrastructure. This however requires a thoughtful approach to private-public partnerships to ensure that the requisite investments are made to facilitate the continued development of infrastructure required to promote innovation and the leveraging of AI. Investment in the areas of research and development will benefit researchers, entrepreneurs and the general global community and go beyond the mere existence of big data centres. The benefits of AI infrastructure are present in our daily lives, largely invisible to the average individual.

Centralized computing power and distributed AI

AI and the benefits thereof are present everywhere. The utilisation of online search engines such as Google, the use of online platforms and interfaces to solicit sales and facilitate purchases, along with the use of Point of Sale (PoS) machines in supermarkets, government offices and agencies and businesses at large, all illustrate the computing power of AI and further illustrate how well distributed this technology is.

Moreover, owing to innovative technologies, AI applications have increasingly become more affordable through cloud computing and the leveraging of modern datacentres. As a result, developing nations are able to benefit from AI technological advancements. At the same time, the further development of access to high-speed broadband internet would be required for a broader uptake of AI solutions. In addition, benefits can be leveraged through the use of non-traditional data.

AI development will depend on the availability and uptake of secure data processing capacities, such as those offered by cloud infrastructure and modern datacentres. These computing infrastructures would host, process and use data, hence supporting the creation of data lakes enabling data analytics and machine learning.

The necessary infrastructure for high-performance computing is being updated. For example, the Centre for High Performance Computing (CHPC) in South Africa is home to the fastest supercomputer on the continent and Senegal has recently built another which already is bringing value with models to analyse and eventually limits the spreading of COVID-19²¹.

AI solutions could be used in a variety of scenarios, from centralized applications, to distributed deployment on smartphones or other devices. Enabling infrastructures from basic electrification to network coverage are fundamental to an effective distribution of AI solutions.

On the other end the critical asset of modern AI is data. Data need to be of high quality, available in large quantity and locally produced to effectively address local problems. Machine learning works by identifying patterns in available data and then applying this knowledge to new data. Thus, the larger the data set, the more subtle patterns in the data can be discovered.

Data quality, quantity and in general terms, availability, is an issue and needs to be considered during the development of an AI strategy. To unlock the value of data, organizations, whether in the public, private or third sector, must examine the ways in which they store, integrate and process data. There is untapped potential in data, that if harnessed, can have implications for helping to solve societies' biggest problems or creating new economic value. Participation in the World Economic Forum (WEF) Data Policy Council²² can contribute to better structure data policy related to AI.

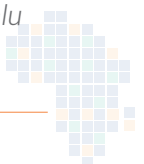
Non-traditional data

To accelerate the development of AI solutions, non-traditional data sources can be relied on. Such data types refer to data which are principally produced for other purposes but may also be used for collateral solutions. The use of satellite images to record changes to the earth's surface in real time and identify unique varieties of crops and flora represents one such example. Metadata captured from the use of smart mobile phones can also be useful for understanding the preferences and tastes of users by demographic. In addition, the movements of a population can be captured and their responses to global pandemics, natural disasters and destructive man-made occurrences, monitored and assessed. Similarly, analyses in respect of tourism and transportation in cities, amongst other use cases can also be monitored. These and other technological applications represent real examples of non-traditional data sources that can be used to accelerate AI usage.

In addition, it is also important to assess the concept of Open Government data within the scope of AI infrastructure.

21 <https://www.hpcwire.com/off-the-wire/senegals-uvs-uses-atos-bullsequana-supercomputer-to-evaluate-covid-19-containment/>

22 <https://www.weforum.org/communities/gfc-on-data-policy>



Open Data

The concept of Open Data promotes transparency, accountability and value creation through increased use and leveraging of available data sources. This does not only increase transparency but also innovation of citizen-centric services by the private sector and by other institutions and networks. Governments are usually in a favourable position to open up public datasets while taking into account data protection and privacy considerations. Various initiatives towards open government data (OGD) have already launched in various countries. This puts the respective AI ecosystem in a position to utilize public data for demand-driven local innovation. In line with the UN Secretary-General’s Roadmap for Digital Cooperation, it is also advisable to develop common standards on open data that can guide the private sector on how to provide open access to datasets. Ultimately, promoting the creation of more openly available datasets holds the potential to facilitate AI innovation and economic development. As AI applications require special kinds of datasets, a technical committee should be installed on the regional level to support such policies. This leverages to technical expertise in an efficient way defining the necessary standards and reducing the barriers for local AI innovation. For this purpose, African countries can pursue different strategies to promote the uptake of these policies and principles and address attendant challenges and shortcomings:

- **define data as a public asset that is crucial to train AI applications.**
- **share AI-ready data nationally and regionally in Africa, we will cover more of those strategies in section 6, where we encourage the definition of a regional roadmap.**

Openly accessible data stimulates economic growth by encouraging businesses to innovate on open data, generating competition, and promoting innovation in public services delivery by the private sector. This contributes to the creation of niche markets for companies that develop AI or offer AI-based services.

Data markets, data collective or cooperatives and data philanthropy

Data collectives or cooperatives are open, community-driven, and standards-based efforts to organize data for a field, discipline, or sector. Efforts to develop data collectives are most common in healthcare, for example, the Global Alliance for Genomics and Health.²³

Data markets are marketplaces for data specifically designed to foster the exchange of data with the private sector. According to UN Global Pulse, in order to accelerate data sharing solutions and increase their sustainability, it would be useful to set up incentives for private sector data sharing, discoverability, metadata management, and data provenance.

Data philanthropy describes a form of collaboration in which private sector companies share data for public benefit.

²³ <https://www.ga4gh.org>

3.6. Networking

An extended ecosystem and public-private partnership are probably the most critical factor for developing an AI landscape that creates value for the country. A country will want to attract and keep researchers and entrepreneurs. And at the same time, to be sure to have investors.

Strengthening a wider ecosystem which includes private sector, industry associations, international organizations, and all national initiatives and stakeholders, will be beneficial for scaling up investments and accessing richer and high-quality data assets. Unlocking the power of private data for public good (eg. data philanthropy initiatives) and leveraging global initiatives will be crucial towards this end.

Extending the ecosystem in this way will also standardize solutions and approaches, favouring the potential intra-African collaborations.

Additionally, the growing focus on AI is contributing to initiatives specifically designed for developing countries fostering collaboration between governments and the private sector. Some examples of these initiatives are UN Global Pulse ²⁴; the GSMA capacity building online learning initiative ²⁵ the IEEE's Government Engagement Program on Standards (GEPS) ²⁶ and the IEEE project to develop "Recommended Practice for Internet Grades of Service in Rural Areas" standard.²⁷

Lastly, increasing participation and contribution in international technical committees ²⁸ will allow a better representation of African countries needs in AI as well as extending networking opportunities at international level.

3.7. Regulations

One of the principal regulatory challenges confronting Africa relates to the fact that AI regulation interplays with a multiplicity of factors and elements. AI systems deal with multiple regions and industries, many of which have their own unique regulatory systems and requirements such as the financial, health and insurance sectors. In addition, AI systems themselves also inherently have challenges of their own (e.g. copyright, patents, competition).

Issues with respect to data protection, data sharing, data localization and open data also represent elements of AI that create challenges vis-à-vis governance and regulation. The ethical management of AI systems and the proliferation of cybercrime also represent challenges confronting the regulation of AI.

The next chapter will explore these in detail.

-
- 24 <https://www.unglobalpulse.org/> - UN Global Pulse is the UN Secretary-General's initiative on big data and artificial intelligence for development, humanitarian action, and peace
- 25 Capacity building is an initiative from GSMA which offers to policymakers, regulators or other relevant stakeholders training like: <https://www.gsmatraining.com/course/big-data-analytics-and-artificial-intelligence-for-impact/>
- 26 <https://standards.ieee.org/about/intl/geps/index.html>
- 27 https://standards.ieee.org/project/1941_1.html
- 28 An example of those committees could be the focus group on "Artificial Intelligence for health" of the ITU: <https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/default.aspx>





4 GOVERNANCE AND ETHICS AN INCLUSIVE PATHWAY

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Governance and Ethics an inclusive pathway

4.1. Governance

A robust governance framework for AI is internationally recognized as critical. Digital governance may be described as “the practice of establishing and implementing policies, procedures and standards for the proper development, use and management of the infosphere”. ²⁹

Existing laws relevant to the provision of electronic services may, to some degree, also be applicable to AI systems. However, AI's processing capacities present opportunities and risks which create challenges for the law, requiring supplementation or amendment of the law.

The ability to get laws properly drafted and passed in parliament will also pose their own unique challenges given the novelty of AI and the nascent stages of AI in Africa as well as more developed countries.

Uninformed approaches to governance can lead to systemic biases and overregulation that can and will stifle innovation, thus limiting the opportunities that can be leveraged and further creating an environment for political abuse. At the same time, under-regulation will result in cultivating a culture whereby trust and confidence is absent, with consumers and citizens being left unprotected.

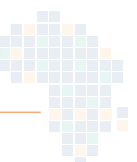
4.2. Key regulatory considerations

An adequate legal framework must take into account several different elements such as the ones listed below:

- ✓ **AI applications** require copyright, patents, unfair competition laws.
- ✓ **Data** requires various mechanisms such as data protection, data sharing, open data, decision on data localisation.
- ✓ **Ethics such as ethical driven design or guidelines for public procurement.**
- ✓ **Legal provisions to enable the business environment** such as incentives, infrastructure, cybersecurity, liability issues, licences.
- ✓ **It cuts across multiple regimes and industries** such as financial markets, health and life insurance, taxation, telecommunication, etc.

While it is still evolving, regulatory approaches to AI are currently a mix of regulations and standards.

²⁹ Luciano Floridi, 2018, *Soft Ethics, the governance of the digital and the General Data Protection Regulation*. *Philos Trans Royal Soc A* 376:20180081.



4.3. Hard regulation

Regulation should not be promulgated unless a particular concern is noted, and that concern cannot be addressed dynamically through marketplace or soft law. In the AI field there are 3 areas where hard regulation is likely the only possible approach:

- ✓ AI systems themselves are (in general) software, and that's governed (and protected) by **copyright/patents**, which are covered by a regulated area.
- ✓ A legal regime that **promotes investment**, focuses on tech transfer/sharing, **protects intellectual property**, and mandates accountability is important and falls under a regulated area.
- ✓ **Unfair competition** or 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.

4.4. Soft regulatory approaches

Over the next few years there will only be few traditional regulations of AI, notwithstanding the increasing deployment and application of AI in a growing range of applications and industry sectors. In the interim at least, this **governance gap** for AI will mostly be filled by so-called **soft law**. These mechanisms include various types of instruments that set forth substantive expectations but are not directly enforceable by government, and include approaches such as professional guidelines, codes of conduct, standards and best practices.

The use of regulatory sandboxes as well as the adoption of standards is already well underway in several African countries. A regulatory sandbox is a framework set up by a regulator that allows FinTech start-ups and other innovators to conduct live experiments in a controlled environment under a regulator's supervision. Mauritius has been using this approach for the implementation of their AI strategy.

IEEE is collaborating with ARSO, Smart Africa, and other African institutions in developing the African **Standards Strategy** for the 4th Industrial Revolution. In addition, IEEE has over thirty AI standards, either under development or active, and pre-standards and standards activities relating to data governance, open data, and digital inclusion more broadly³⁰. IEEE has also published the Ethical Aligned Design (EAD), which include pre-standards activities and a certification framework. This can be used as reference to define ethical compliance for AI governance. ISO-IEC JTC 1/SC 42 is producing a series of standards and best practices for the use of AI. In addition, the integration of standards at an informal level in some grassroots AI initiatives is already taking place (e.g. in modelling agreements).

Another example of soft regulation is provided by the UK where an agile approach was used to help AI technologies benefit humanity, and at the same time mitigate the risk of negative externalities. Government procurement of AI is worth 9 trillion USD per year. National Governments, by procuring AI products for the national government, can begin

³⁰ <https://standards.ieee.org/industry-connections/diita/index.html>

to kick start the AI economy in the country. For example, the **UK** defined 10 high-level principles and guidelines for procuring AI. This can kick start the economy but can also "lead by example" in terms of procuring ethical AI. By doing so UK created an iterative agile governance around an evolutionary technology.

4.5. Data Aspects

While section 3.5 acknowledges types of data that would allow developing countries to accelerate the development of AI, this section presents objectives to be met in securing access to data. As already covered, AI needs vast amounts of data to be developed.

There are several regulatory issues relating to data in AI:

- ✓ There is a risk of undermining **privacy and ownership**, even when the use of this data is for benign / 'public good' purposes. At the same time, data sharing and open data is necessary given the need for vast amounts of data both for public planning and service delivery purposes as well for training the AI and scientific endeavours. Data can further public interest by informing decision-making.
- ✓ **Data protection principles** (DPPs) – DPPs are pertinent in regulating AI where personal data is processed and will protect the privacy of such data. Data protection principles outline how data users should collect, handle and use personal data. DPPs face challenges in being applicable to AI in several areas. Data that was initially collected for non-AI purposes may only be used if there is similarity in the original and subsequent purpose. Where non- personal data is processed, such as anonymized data and industrial machine generated data, DPPs are not applicable.

UNCTAD produced a lists of different data laws and regulations for countries worldwide : <https://unctad.org/topic/ecommerce-and-digital-economy/ecommerce-law-reform/summary-adoption-e-commerce-legislation-worldwide>.

Pathway for a competitive AI landscape

Access to data is a key ingredient for a competitive AI landscape. African nations can address these issues by meeting these objectives:

- ✓ Implementing a **data strategy** with practical recommendations for establishing a data market infrastructure to promote data access and voluntary data sharing. This will contribute to the enhancement of the quantity and quality of data that is readily accessible.
- ✓ Addressing deficiencies in **data privacy and data protection legislation** and other relevant laws and policies to address risks stemming from AI.
- ✓ Proffering recommendations on **information exchange regimes** and arrangements between the public and private sectors in compliance with data protection laws.
- ✓ Developing and tailoring technical means for **data de-identification, transfer and processing**.



4.6. AI and Ethics

Automated systems are used to analyse data based on which humans make decisions. Sometimes the connections drawn by AI systems would not normally be considered by humans. Such decisions might have ethical/moral impact, e.g. relating to health or the ability to access public services (housing, social security benefits), or restricting access to social media. This increases risks for administrative decision-making.

This creates a dilemma as even the best programmed device cannot totally replicate the human mind and can make mistakes. In this sense, the ethics of AI also include a collective component, i.e. where the AI application affects society or specific groups of individuals in a consequential manner. There is a need to ensure that ethics are integrated into AI systems to minimize structural discrimination and bias that can emerge from biased training data³¹. Repercussions can lead to discrimination and impairment of rights in a myriad of circumstances including housing, medical care, education, and human rights.

In designing their national AI Strategy, countries should clearly elaborate the AI ethical framework. For example, in line with the Recommendation 3c of the report of the UN Secretary-General's High-Level Panel on Digital Cooperation, the use and development of AI systems should be safe and trustworthy. Additionally, it requires that "autonomous intelligent systems should be designed in ways that enable their decisions to be explained and humans to be accountable for their use. Audits and certification schemes should monitor compliance of artificial intelligence (AI) systems with engineering and ethical standards, which should be developed using multi-stakeholder and multilateral approaches. Life and death decisions should not be delegated to machines. AI systems should be designed taking into account such key concepts as people, the planet, prosperity and peace. According to a recent study of 84 sets of AI ethics guidelines, the most common principles included are transparency, justice & fairness, responsibility, non-maleficence, privacy, beneficence, freedom & autonomy, sustainability, dignity, and solidarity.³²

However, while there are many precepts, themes and principles that can be applied to AI ethics, universality is not one of them. "Fairness," "privacy," and "bias" connote different things in different places. People also have distinctly different expectations of these concepts depending on political affiliations and socio-economic realities.

Accordingly, one of the principal challenges and risks posed with respect to AI relates to the fact that the interpretation of relevant concepts and terms can vary so vastly that it may be difficult to create general definitions and interpretations to be broadly applied internationally. Organisations working globally on AI must acknowledge and address this challenge in an effort to develop meaningful standards that can be applied multi-regionally. In the absence of such recognition, there will be the unfortunate proliferation

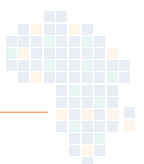
31 STAT Health Tech Newsletter "Even those that do disclose data often don't include the racial, gender, and geographic breakdown. Among breast imaging tools, for instance, only one of 10 products disclosed the demographics of the dataset"

32 <https://www.nature.com/articles/s42256-019-0088-2.pdf>

of the current biases and inconsistency of application and interpretation of terms. Companies must therefore work on developing ethical guidelines for AI systems in tandem with users globally to ensure that they appreciate and infuse the widest cross section of viewpoints and inputs. This will be the most appropriate approach to the creation and application of standards.

The approach to the establishment of institutional and governance frameworks and arrangements governing AI systems must acknowledge that there is a need to include representation from the widest cross section of the global community. In the absence of this, AI ethics will be at grave risk of reflecting limited, skewed and unrealistic viewpoints and concepts. Should the intended outcome be to develop ethical, safe, and inclusive AI systems, inclusivity must also be a theme in the institutional governance frameworks; inclusion can only commence with meaningful engagement and a participatory approach.

Ethical standards have been used to determine what is acceptable, and business or government responsibility for AI-based decisions. While there are dozens of AI ethics initiatives around the world today with the aim of pre-empting and preventing possible negative impacts, it has been highlighted that many of the councils and advisory boards which guide, govern and regulate ethical matters in respect of AI are replete with representatives from the larger developed nations, notably Europe and the United States. Participation from African nations is crucial and should be further encouraged.





5 USE CASES FOR AI MADE IN AFRICA FOR AFRICA

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Use cases for AI made in Africa for Africa

5.1. AI as a horizontal technology

AI can help improve communication with communities and populations that are left behind. For instance, AI-powered voice recognition can help people use telephone hotlines in their native languages. This means that an illiterate farmer in Rwanda could speak to a computer in Kinyarwanda, her native tongue, to get crucial advice on improved farming methods. As an estimated 2,000 native languages are spoken in Africa, voice interaction models in these languages can reach large amounts of people.

In Rwanda, the local start-up **Digital Umuganda**³³ is collecting voice language data in the local language Kinyarwanda. The data is openly available on the Mozilla Common Voice Platform and can be used to develop AI based voice interaction models in Kinyarwanda. For instance, Digital Umuganda is developing a text to speech model which reads government and other publications and announcements to people who are visually impaired or cannot read.

Harambee³⁴ is a social enterprise that develops innovation approaches to tackle the global youth unemployment challenge. The key element of their business model is a unique combination of technical ingenuity and local knowledge. Harambee leverages its local network of partners in South Africa and Rwanda, as well as AI-driven analytics to match potential job candidates with employment opportunities.

5.2. AI4 Agriculture

Agriculture is one of the key sectors in the region and is critical to Africa's growth. Overall, the sector employs over 65% of the labour force and contributes to 32% of gross domestic production (GDP)³⁵. Demand for food is increasing in the continent and worldwide due to population growth and is projected to double in 2050. It is estimated that a 1% increase in crop productivity will reduce the number of poor people by 0.72% in Africa.³⁶

Agriculture is experiencing a digital transformation worldwide, where combined technologies are bringing automation and support, leading to greater efficiency and increasing yields. This digital transformation of the agricultural sector is often referred to as smart agriculture or precision farming.

Role of AI

AI could play a big role in the whole value chain, from financing creditworthy smallholder farmers, to supporting production by analysing and predicting diseases and pests, as well as facilitating the creation of cooperatives and promoting greater price control.

33 <https://digitalumuganda.com/>

34 <https://www.harambee-africa.org/>

35 FAO/OECD Agricultural Outlook 2016-2025

36 Colin Thirtle, Lin Lin and Jenifer Piesse, "The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America," *World Development* (Vol 31 Issue 12), 2003.



The general lack of data and poor data quality could be addressed with the use of non-traditional data like satellite imagery to analyse crops, mobile phone data to monitor transfer prices or external weather data to predict productivity.

Support tools like chatbots or translation technologies could be extremely beneficial for making useful information more distributed and accessible, as well as improving inclusion and reducing poverty.

This will have even a bigger impact in the future, with the adoption of complementary technologies like drones or Internet of Things devices.

The main challenges in the adoption of AI could revolve around digital and last mile infrastructures, as well as a lack of both tech literacy and AI related skills.

Use cases and best practices

The sector is extremely relevant, and a number of use cases are already being implemented including **Zenvus**, a Nigerian data driven agriculture startup, or **Ujuzikilimo**, a big data platform which both could be considered a best practice.

In the lending space there are cases like **FarmDrive** and interesting initiatives like **Agrospaces** to support farmers across Africa with live pricing data.

The Kenyan smartphone application **Eska** allows farmers to return an automated AI-enabled analysis on potential diseases of plants through their phone cameras.

Another best practice could be extending those collaborations with tech companies and research institutes. An interesting example of this is the **Sowing APP**, a solution delivered in the Indian state of Andhra Pradesh, to optimize the sowing of seeds depending on forecasted weather conditions, soil and other indicators. This initiative was realized through a collaboration between the Andhra Pradesh Government, the Crops Research Institute for the semi-arid tropics (ICRISAT) and Microsoft and has delivered a 30% higher average yield per hectare.

Challenges

These use cases highlight the need for high-quality local data which offers the potential to tap into a vibrant start-up community and foster the development of standardized solutions that will be more meaningful and effective.

High-quality data could be generated, gathered and shared across several countries and regions, and could become one of the most valuable assets on which to build solutions. There are already academic initiatives in these areas, with research targeted to generate high quality datasets like the necrotized cassava roots images dataset³⁷ that could be an asset for the entire continent.

37 2020, Joyce Nakatumba-Nabende, Benjamin Akera, Jeremy Francis Tsubira, Solomon Nsumba, Ernest Mwebaze “A Dataset of Necrotized Cassava Root Cross-Section Images

5.3. AI4 Education

A huge transformation is taking place in the education sector worldwide, with the release of more and more free accessible contents on MOOC platforms like Coursera, Atingi, the Khan academy or Smart Africa Digital Academy. This, jointly with the growing demand for digital skills, is leading to disruptive initiatives like 42 University in the Silicon Valley or Molengeek in Belgium. These initiatives are providing free, high quality digital education to disadvantaged people, supported by companies and technology vendors seeking qualified professionals to fill the digital skills gap.

Education could be the single biggest area to invest in, both to facilitate the development of education on the continent and to accelerate the creation of digital and AI specific skills that will foster the diffusion of the AI economy.

Budget constraints limit digital infrastructures and language barriers could pose challenges towards developing a more effective digital education system and AI could contribute to solutions.

Role of AI

AI for education is traditionally referenced as AI4Ed, and it is expected to have an impact in several areas of education, contributing to improvement in efficiency and accessibility.

Examples include language learning or intelligent tutoring, student support with continuous assessments or grading, learning companions or course recommendations; teacher support through auto-test generators, plagiarism detection or open education resources recommendations (OER); and education system support using optimal data for resource allocation, predicting dropouts, or diagnosing learning disabilities like dyslexia. In all such scenarios, there are horizontal solutions which could be impactful in the AI education landscape like conversational interfaces, or automated real time translation tools.

Use cases

GeorgiaTechUniversity (GTU) – GTU developed Jill Watson, an AI teaching assistant based on IBM's Watson platform. The system was developed specifically to handle the high number of forum posts by students enrolled in an online course that is a requirement for GTU's online master's degree in computer science. It attained a 97% accuracy rate in answering student queries, and according to reports by GTU, most students were unaware that "Jill Watson" was not a real person.

China is developing AI technology to understand the general logic and meaning of text in academic essays and make a reasonable, human-like judgment about their overall quality. It then grades the work, adding recommended improvements in areas such as writing style, structure, and theme. The technology, which is being used in around 60,000 schools, is supposed to analyse more deeply than a standard spellchecker. The technology is designed to assist, rather than replace, human teachers as it could help to reduce the amount of time they spend on grading essays and help them avoid inconsistencies caused by human errors such as lapses in attention or unconscious bias.



ETS –Educational Testing Services is a company where education experts use an e-rater to identify specific features indicative of writing proficiency in student essays to score more efficiently and offer better feedback. The e-rater engine provides a holistic score for an essay as well as real-time diagnostic feedback about grammar, usage, mechanics, style, organization, and development. This feedback is based on natural language processing research specifically tailored to the analysis of student responses. Teachers use the tool to help their students develop writing skills independently and receive automated, constructive feedback. Equally, students use the engine's feedback to evaluate their essay-writing skills as well as to identify areas that need improvement.

M-Shule is an SMS-based learning platform used in Kenya, which uses AI to track and analyse student performance and to deliver personalized lessons that satisfy their needs and increase their competency.

Squirrel AI is a solution developed in China which restructures learning. The AI simulates human teachers and gives students detailed personalized learning plans and one to one tutoring. The company's studies suggest between 5 to 10 times higher efficiency than traditional learning courses. The system has proven most effective when applied to basic skills (like middle school mathematics).

5.4. AI4 Health

Globally, the most critical issue in healthcare is providing overarching and effective treatment options that improve standards of living. The World Health Organization (WHO) has developed a five-year strategic plan for reaching public-health targets, as outlined in the Sustainable Development Goals (SDGs). In 2019, the WHO introduced the "triple billion" targets for global health: universal healthcare, health emergency protections, and overall better health outcomes for one billion people across the world.

In this context, healthcare is going through a digital transformation where data plays a more crucial role. There are relevant needs for this transformation, from an aging population, to more and more chronic diseases, to increasing costs in the system. Digital technologies and new approaches are pushing the so-called 4P Medicine, which is supposed to be Personal, Preventive, Participative and Predictive.

Data and AI are central in all these transformations, enabling several of these outcomes and supporting more evolved clinical analysis like the so-called omics (genomics, proteomics, metabolomics).

Role of AI and existing biases

AI can help in several ways, through tackling practical challenges, enhancing outcomes and eventually promoting leapfrogging to more modern healthcare technologies where traditional systems are struggling to transform.

- ✓ The area of impact is extremely horizontal and includes inter alia:
- ✓ empowering and supporting medical staff;

- ✔ augmenting scarce personnel and facilities to do more and focus on clinical outcomes by automating initial processing, triage, diagnoses and post-care follow-ups;
- ✔ improving diagnostics and detection with computer vision applied to medical imaging;
- ✔ facilitating healthcare access with chatbots in local languages to extend access to millions of remote people through the use of smartphone cameras for pre-screening or diagnoses.

Other roles for AI could focus on improved, personalised healthcare delivery, where specific genetic or biological markers could be used to tailor specific medical interventions, or preventive care. For instance, early diagnosis systems could be used to identify diseases like chronic kidney disease (CKD) before the need for dialysis or advanced stage disease complications.

Finally, AI could be useful in preventing fraud to healthcare systems or speeding up reimbursements from insurances or other specific stakeholders.

Use cases and initiatives

There are several prominent health use cases such as predicting birth asphyxia using a smartphone, identifying weather and land-use patterns associated with dengue fever transmission, and applications for providing appropriate cancer treatment recommendations.³⁸

In terms of local cases we could cite **Babyl** which is a digital healthcare provider in Rwanda that collaborates with the national healthcare scheme to make healthcare more affordable. Among other things, Babyl Rwanda uses AI and machine learning to provide medical advice and organize appointments through mobile applications. While this is not yet part of their services, the company plans to support AI-based medical diagnoses.

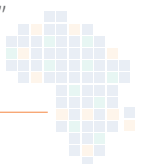
There are also relevant initiatives which could be beneficial not only to push the usage of AI in healthcare for Africa, but also for developing education, human capital and attract investments in this area. Among these initiatives, the Data Science & AI summit for Health³⁹ in Africa presents an ideal case study.

Challenges

Healthcare systems in Africa face several structural challenges. National medical systems often suffer from shortages of qualified healthcare professionals or supplies, resulting in divergent outcomes for patients depending on the facility and service that they need. In addition to accessibility barriers and rural and urban disparities, lack of awareness on health issues can be a barrier to seeking care, receiving more effective treatments, and to more effective public health policies. Even when facilities and staff are available, affordability can put needed services out of reach of patients.

38 *Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings?* (Wahl et.al. 2018)

39 <https://dashinafrica.org/>



There is a need to have local data which will be more significant and relevant in several of these use cases. Several studies pointed out that the majority of the existing datasets used in AI for healthcare come from a limited number of cohorts in specific regions / areas, and there are still only a very limited number of datasets which are relevant for Africa.

This might lead to problems related to the concept of algorithmic bias, which is an important factor in the development of AI products and applications: modern AI will be as good as the data which is trained on, and using datasets from outside Africa could lead to those biases. Overall, the use of AI in the health sector requires particular consideration of ethical issues, data protection and privacy as it often relates to sensitive data as well as far-reaching decisions pertaining to people's well-being.

COVID-19, data, and AI

AI has played a big role during the COVID-19 pandemic, especially for countries like China, Singapore, or South Korea, where AI was already quite developed.

China, the first epicentre of COVID-19 and renowned for its technological advances in the field of AI, has used this capacity to its advantage. China has deployed AI in support for measures restricting the movement of populations, forecasting the evolution of disease outbreaks and research for the development of a vaccine or treatment. With regard to the latter aspect, AI has been used to speed up genome sequencing, make faster diagnoses, carry out scanner analyses, as well as to handle maintenance and delivery robots.⁴⁰

AI is also contributing significantly to speeding up the time to find a vaccine, with Moderna and Google, with AlphaFold AI.⁴¹

Combatcovid-19 is a platform⁴² to mobilize AI and data science towards combatting the pandemic in Africa. The platform brings together data scientists to solve Covid-19 related problems.

5.5. AI4 Financial Services

Financial sector development has been identified as a key factor in reducing poverty in developing economies⁴³. AI has the potential to achieve this by changing the way Africans access financial services, save money, invest, and get insured.

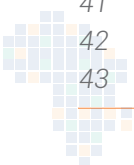
African banking markets have been described as some of the most exciting in the world: they are fast growing, nearly twice as profitable as the global average, and a hotbed of innovation.

40 2020, A. Chun, "In time of Coronavirus, China's investment in AI is paying off in a big way"

41 <https://fortune.com/2020/11/30/covid-protein-folding-deepmind-ai/>

42 <https://www.combatcovid-19.africa/>

43 2018, IFC, Digital Access- the future of financial inclusion in Africa.



Leading actors in the sector have been proactive and innovative in developing new business models in response to the specific challenges of the region including low levels of banking penetration, heavy use of cash, sparse credit bureau coverage, and limited branch and ATM networks. A growing number of tech savvy African customers demand very sophisticated banking service.

Recent studies suggest that approximately 40% of African banking customers prefer to use digital channels for transactions over branch channels. Furthermore, in the continent's major banking markets, including South Africa and Nigeria, this share is significantly higher. For example, in Nigeria, 59% of customers prefer digital, compared to 15% that prefer branches.⁴⁴

Digitalization and innovation are key factors in financial services providers' ability to grow and distinguish the leading from the lagging. Financial institutions must continue to innovate and embrace cutting-edge technology such as AI and leverage analytics and data to create efficiencies, reduce costs, and improve customer experience. This technology will also enable them to automate their processes seamlessly to achieve improvements in frontline productivity and open new streams of revenue to remain competitive. Equally, it can help improve financial institutions' (FI) risk management, credit allocation, and fraud detection capabilities, as well as increase their share of digital sales and transactions. Likewise, FI's should partner with FinTech start-ups and SMEs developing AI solutions for financial services.

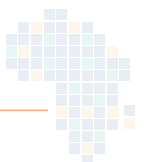
Role of AI

AI technologies are already widely adopted in the financial services sector, there are even cases of banks which are building their business model to a full digital model fully supported by AI like the German bank N26. Here the role of AI is various and extensive. This includes automating and improving the efficiency of operations and controlling processes, mitigating the risk of fraud and money laundering activities, optimising general user experience, and extending accessibility with voice channels or automated translations.

Use cases

Zenith Bank Plc - Located in Nigeria, Zenith launched several new solutions that enable more convenient, safe and quick customer transactions. These include the bank's Scan-to-Pay App which can be used by Zenith and non-Zenith customers to make online and in-store payments in seconds through quick response code scanning on any internet enabled phone. The bank's mobile app also offers enhanced functionalities such as instant account opening for new customers.

ALAT - Africa's first fully digital bank, launched in May 2017 by Wema Bank in Nigeria. ALAT targets the youth segment based on the three pillars of convenience, simplicity, and reliability. Customers can open an account via mobile phone or Internet in under five minutes and debit cards are delivered anywhere in Nigeria within two to three days, free of charge. ALAT also promises "no paperwork". Photos of know your customer (KYC) documents can be uploaded via mobile app or website.



Strider - A South African fintech company that provides a toolbox of platforms that banks and financial institutions can rapidly white-label in order to provide financial education and meaningful services to new and existing clients.

5.6. AI4 Energy and Transportation

AI can be harnessed across the global economy within a wide range of sectors to better manage our environment. Energy and transportation are two key sectors in this regard. AI has the potential to drive higher efficiency in the energy sector through intelligent grid systems that utilize deep predictive capabilities to manage supply and demand, optimizing renewable energy solutions. In this way, AI has the power to support decarbonization, as well as contribute to the UN's Sustainable Development Goals by ensuring a supply of affordable, reliable, and clean energy to all.

AI applications in the transport sector can allow cargo and people to move between places more safely, efficiently, and sustainably in an increasingly globalized and urbanized world. As an example, AI technologies have a large role to play in enabling more accurate traffic prediction, real-time journey planning, and in the near future, autonomous vehicle technologies.

In a joint study conducted by Microsoft and PwC, it emerged that using AI for environmental applications in energy and transport sectors have the potential to impact gross domestic product (GDP) by 1.3% and greenhouse gas (GHG) emissions to -3% by 2030 in the Sub-Saharan Africa region.⁴⁵

In the African context there are two other important factors to consider for pushing AI adoption in these sectors: Firstly, through targeted investment today in digital infrastructures and upskilling, there is an opportunity to leapfrog developed nations which are looking for ways to reduce their emissions and produce solutions and skills that could contribute to a substantial economic and environmental gain. Secondly, the ability to substantially attract international skills and investments which are increasingly focusing on those challenges.

Role of AI and forward looking

AI in the energy and transportation sectors plays a fundamental role even if the highlighted outcomes rely on bringing together several factors. Solutions here, in most cases, are realized with multiple complementary technologies: Robotics, the internet of things, distributed energy resources, electric vehicles, modern solar photovoltaic panels or wind turbines are pieces of a wider transformation which is accelerated or enabled by AI.

For example, in the energy sector AI-enabled distributed energy grids will reach their maximum potential with the adoption of related innovations in distributed grid infrastructure including distributed generation, distributed storage, industrial IoT, electric vehicle charging, dynamic pricing, and smart meters. Likewise, in transport, AI-

⁴⁵ <https://www.pwc.co.uk/services/sustainability-climate-change/insights/how-ai-future-can-enable-sustainable-future.html>

enabled autonomous vehicles must offer more than energy efficiency gains through smart navigation and eco-driving, but also ultimately be electric vehicles and incentivize ride-shares, to counter a potential rebound effect of increased vehicle miles.

Use Cases

AI in **energy sector** is mainly used in the following scenarios:

Smart monitoring and management of energy: In conjunction with IoT technologies, monitoring and actively managing energy usage will bring improved efficiency and thus automated price responsiveness that could enable fairer and more accessible prices.

Energy supply and demand prediction: AI could be deployed both at a macro (region, area) or micro level (company, group of households), and could include external factors in the prediction like seasonality and weather. This could result in better management of fluctuations and reductions in overall consumption and waste.

Micro and decentralized energy networks (grids): AI allows better management of localized energy grids, automated operations and improved overall efficiency. This could offer a significantly improved return on investment, allowing a wider distribution of such grids in many areas.

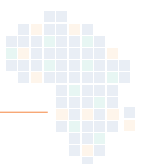
Improving the efficiency and effectiveness of renewable assets: AI could play a big role in accelerating the distribution of renewable assets for energy generation. This could include hyperlocal weather modelling used to monitor and adjust the positioning of solar panels and wind turbines, drones and cameras for monitoring defects in photovoltaic plants, and optimizing predictive maintenance to reduce downtime and maximize output.

The added value provided by this optimized efficiency is to lower the cost of accessing and distributing these technologies which brings significant social and economic benefits to areas and society; extending inclusion and sustainability.

In the transport sector AI is widely used at a personal level. Applications like Waze or Google Maps rely on AI to track changes, analyse, and recommend best routes for individuals. These consumer-focused tools can be scaled up for commercial and organisational use by companies, cities, or regions.

By collecting, refining and sharing data related to routes, parking lots, service or charging stations, any area could benefit today from traffic optimization tools, demand prediction and logistic planning enabled by AI.

With the continuous development of connected, electric and in the future, autonomous vehicles both personal and industrial, a new wave of autonomous deliveries and car sharing will offer a more efficient, cheap and sustainable transport system. This is crucial in a world where cities are becoming bigger and with growing populations.



For public sectors and government, monitoring and predictive maintenance of any kind of vehicle could be beneficial not only for maximizing the usage of those, but also to make usage more efficient, saving operational costs and reducing impact.

5.7. AI4 Climate change

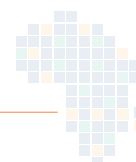
Climate change is reasonably the biggest challenge that the world is facing. Africa has not been contributing significantly to the human impact on climate but is suffering from the changes.

There are a growing number of initiatives that could contribute to overall adoption of AI in Africa (e.g. climatechange.ai, a global AI community of experts and scientists dedicated to combatting climate change). Additionally, AI for Earth is an initiative by Microsoft that generated solutions like Zamba Cloud; a free and open AI solution for supporting biodiversity.

AI For Earth offers not only technical resources but funds and grants. Tapping into the vast amount of talent and funding available to fight this challenge could be greatly beneficial for the continent.

When referring to energy and climate, it is important to cite the global covenant of mayors for climate and energy⁴⁶ which is vastly diffused in all Sub-Saharan Africa with 220 cities committed. This organisation is a potential collateral initiative which could offer significant synergies.

⁴⁶ <https://www.globalcovenantofmayors.org/>





6 ROADMAP FOR AI IN CONTINENTAL AFRICA

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Roadmap for AI in continental Africa

6.1. AI in Continental Africa

The Smart Africa AI working group identified the following strategic levers to support AI at the continental level:

- ✓ Jointly shape policies
- ✓ Create a data collaborative space for Africa

6.2. Jointly shape policies

Given the transnational nature of AI and data, continental and regional policy coordination becomes important for shaping policies. For instance, the African Union Convention on Cyber Security and Personal Data Protection encourages coordination among member states with the aim to create a uniform regime for Cyber Security and Personal Data Protection. This far, 14 countries are signatories.

Peer-to-peer exchange and benchmarking mechanisms between African countries may support policy formulation. For example, Smart Africa set up a regional working group to exchange best practices on effective design and implementation of AI national strategies. Along with policy makers, this group includes representatives from industry, civil society and academia to make sure that policies are enabling innovation and respect ethical considerations.

6.3. Create a data collaborative space for Africa

In previous chapters we covered the need for sharing data to accelerate the development of AI research and solutions. We also have highlighted the regulatory need to find a balance between safeguarding privacy and using data for public good, including for training AI models. Here we cover a wider aspect of data sharing, where data could be shared among countries or regions to accelerate AI innovation and create harmonised standards. Data sharing can trigger better research, development and optimise investments in AI in the region.

Open government (public sector) data governance models are rather complex to implement. The European Commission is currently evaluating governance principles for the so-called European Data Spaces. The objectives are clear, and seem to map well onto those in this blueprint for Africa:

- ✓ Make better use of publicly held data for research for the common good
- ✓ Support voluntary data sharing by individuals
- ✓ Set up structures to enable key organisations to share data

Regional Collaboration on open government data

A clearly defined roadmap should be set up to arrive at a joint understanding of data as a public asset on a regional level. Given its great importance for AI-driven innovation



and economic growth, African countries should leverage the power of openly accessible data and open government (public sector) data. The roadmap consists of a pre-defined number of conferences and workshops including governments, civil society, industry and academia. At the end of the process is a document that defines recommendations for the definition of AI-ready training data as a public asset, technical data standards as well as measures to support the ongoing digitalization of public service delivery across Africa.

The following **measures** can be implemented to address the issues detailed above:

- ✓ Strengthening technical infrastructure to support data sharing.
- ✓ Crafting an open-source data handling toolkit.
- ✓ Increasing ICT capacity through the deployment of local technological capacity and strategic investment in projects in the fields of privacy and data engineering. The IEEE has various pre-standardization and standardization activities in the field of privacy preserving data processing, e.g. federated learning, supporting open data infrastructures, and looking at data trading applications⁴⁷. Establishment of independent advisory councils at national and continental levels to provide counsel with respect to guiding principles on ethical AI.
- ✓ Exploring data sharing initiatives at the continental level, including under the Africa Free Trade Agreement.
- ✓ Employing an inclusive and participatory approach to leverage lessons learnt from regional and national initiatives to develop AI strategies across the region.
- ✓ Establishing incentives to enhance the vibrancy of data markets and enabling a sustainable data access framework. This implies, first of all an assessment of how the region's data protection legislation compares with other regional and national frameworks on data protection. It should eliminate uncertainty for private sector actors conducting international data transfers and processing. Second, it should provide recommendations for the manner in which the private sector can share data with the public sector for the public good in compliance with data protection laws. Third, it should provide support to develop and adapt technical means for data collection, anonymization, transfer and processing. Fourth, it should establish incentives such as tax breaks, certificates of good character or compliance and indicators of corporate social responsibility.

47 <https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/open-big-data.pdf>

6.4. Computing Infrastructure

Built on existing and future national cloud infrastructures, the continental computing infrastructure would support the needs of AI centres of excellence, academia, companies and the public sector. Setup as a pan-African cloud, it would leverage countries' own computing infrastructure and data environments at a continent scale, providing shared resources and on-demand computing capabilities across Africa, i.e. an African data and computing space. In order to reach this goal, the following actions are proposed:

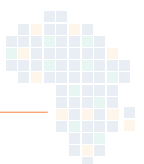
- ✓ Technological capacity building
- ✓ Federated secure cloud platform

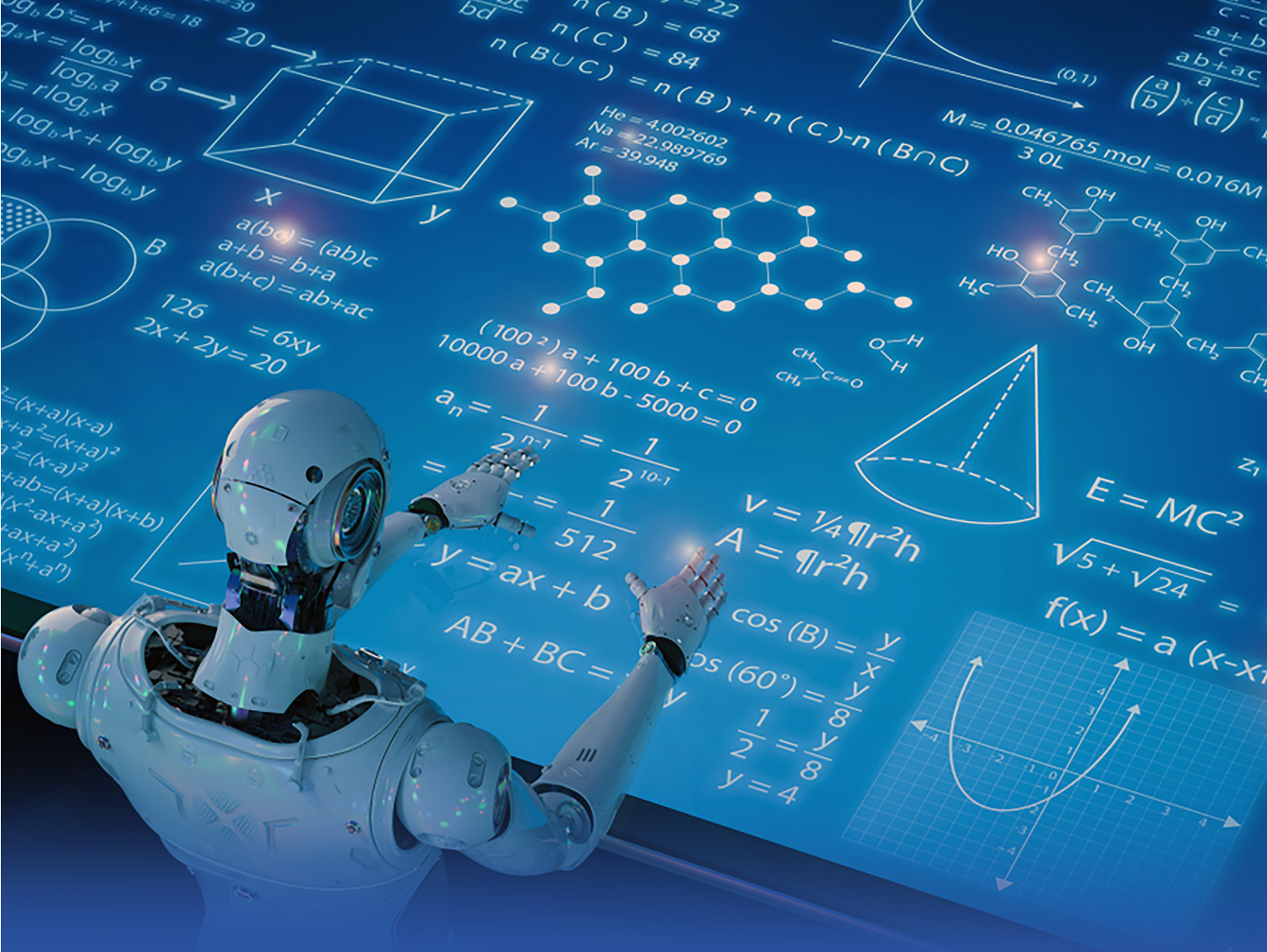
A technological capacity building plan

In order to meet the AI ambitions of Africa, an inventory of existing computing capacity would be required, in order to estimate the required architecture, tools and processes. These could include support for High Performance Computing capacities, data interoperability, AI platforms and tools. The potential to address specific priority sectors (e.g. healthcare, agriculture, government) should be taken into account to drive cybersecurity, privacy and data governance aspects. It is also essential to ensure proper investment in the development of local cloud storage and computer solutions (e.g., CloudAfrica). Otherwise capacity building might present a bottleneck to AI application development.

Federated secure cloud platform.

The design of a federated secure cloud platform would augment the region's computing capacities by combining shared investments. This open, trusted, virtual, federated environment would provide services to store, share and re-use data across the region. Services, platforms and tools would support AI innovation and adoption. A governance structure and rules of participation would ensure its fair access.





7 CONCLUSIONS AND RECOMMENDATIONS

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Conclusions and Recommendations

Conclusion 1- AI is part of a wider national strategy

Adoption of AI requires investments in different areas (people, technology, research), but also governance to address ethical concerns and regulations. For this reason, decision-makers should closely consider the national priorities to be addressed by AI; whether related to an aging population (e.g. in Japan), or economic, social and traditional sectors (e.g. Mauritius). When addressing AI as part of national strategy the **recommendation** is to review how AI can support national dominant industries and sustain national values.

Conclusion 2- Five key dimensions to implement an AI national strategy

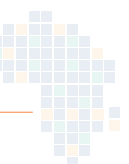
A strategy is never complete, and must be revisited, updated and adjusted on a ongoing basis. Citizens will see little impact without concrete actions. Although there is no one-size-fits-all plan in Africa, this blueprint recommends intervening in 5 broad areas (more details in Chapter3):

- ✓ **Human capital** targeting policies to foster the educational development in the field of artificial intelligence. It includes aspects of formal education and training (e.g. reforms of educational systems towards inclusion of AI courses and programs), vocational and continuing education (e.g. training of existing workforce to obtain AI-related skills and competences), and labour market intelligence and needs (e.g. identifying forthcoming skill needs due to changes in technology developments).
- ✓ From the **lab to the market** encompasses policy initiatives to encourage research and innovation in AI towards business growth in the private sector and increased efficiency of public services. This section also includes policy instruments to facilitate testing and experimenting with newly developed AI pilots and services.
- ✓ **Networking** presents policy initiatives related to AI collaborations across private and public sectors directed towards increasing the attractiveness of the country (e.g. policies aiming at attracting foreign AI talented individuals and firms to the focal country). This category also includes policies related to the dissemination and uptake of AI such as promotional campaigns and mapping of AI players and applications.
- ✓ **Infrastructure** covers initiatives to encourage data collection and responsible usage, as well as to foster digital and telecommunications infrastructure.
- ✓ **Regulation** highlights policies for the development of ethical guidelines, legislative reforms and international standardisation.

Conclusion 3-Empowering the ecosystem in Africa

We have learnt from successful experiences in other countries that engaging stakeholders of the AI ecosystem is essential to accelerating AI adoption (e.g Canada). Listed below are some of the **recommended** initiatives for African countries interested in strengthening the AI ecosystem:

- ✓ Establishment of national and regional investment programmes and incentives



(e.g. financing and funding programmes for R&D; private and public partnerships, tax breaks).

- ✓ Design and implementation of AI Centers of Excellence to support innovation.
- ✓ Establishment of incubators and accelerators for start-ups, which can provide training and accelerate AI developments.
- ✓ Cultivation of an AI talent pool of human resources (e.g., STEM education, coding skills, higher education for academic research). Each country needs to have the talent map of the AI ecosystem.
- ✓ Promotion of success stories and AI use cases made in Africa for Africa (ref. Chapter 5).
- ✓ Map, benchmark and share lessons learnt on national AI ecosystems. This may lead to better understand local opportunities (e.g., start-ups, tech hubs, educational institutions) and obstacles (e.g., data access, broadband availability, lack of funding).

Conclusion 4- Finding balance between an AI enabling environment and the associated ethical and legal governance challenges

Chapter 4 illustrates that AI governance doesn't necessary imply stringent regulations. Technology moves quicker than regulations and policies. It is important to define agile ways to help technologies benefit humanity and the planet, while mitigating the negative externalities that may emerge.

The following **recommendations** will assist decision-makers in finding a balance between an AI enabling environment and the associated ethical and legal governance challenges:

- ✓ Establishment of regulatory sandboxes.
- ✓ Increased participation of African delegates in international and regional technical committees for AI-related standards.
- ✓ Promotion of public sector adoption of AI towards efficient public services. For instance, the UK's AI development fund or Germany's and China's incorporation of AI into the public sector. Government procurement plans for AI not only promote economic growth, but also should "lead by example" in terms of procuring ethical AI.

Conclusion 5-Intensify funding, interest and research on AI to become a rising star on AI

In chapter 5 we explored several AI uses cases in various sectors in Africa, along with the associated challenges. However, rising stars in AI (e.g., Singapore, Israel, Ireland and Finland) have shown that it is possible to outperform the larger countries (e.g. China and US) in terms of the intensity of the AI development, whether through large relative investments, or by consistently producing valuable research.

Today, African nations in particular attempt to seize the opportunity artificial intelligence offers for sustainable development (e.g. Tunisia, South Africa, Morocco, Egypt, Kenya, Nigeria, Mauritius, Senegal). They lack the breadth of larger countries and traditional champions, as well as the intensity of the rising stars, but do well in specific areas with a concrete plan in place. To reach the level of rising stars in AI, it is **recommended** that countries intensify the following:

- ✓ Investments in AI companies
- ✓ Interest in AI, by supporting grass root AI initiatives
- ✓ Quality of research, assessed, for example, by the number of citations of their AI related research

Recommendation 6- Increase capture, sharing and use of non-traditional open data and data philanthropy

Chapter 3 of this blueprint explains the importance of data quality, quantity and availability for AI development. Given the fragmented nature of data across the African continent, it is **recommended**:

- ✓ Utilisation of non-traditional data sources (e.g., mobile data, satellite data).
- ✓ Promotion of, and engagement with data philanthropy. Data philanthropy is defined as sharing of proprietary data in ways that the public can benefit from. The term philanthropy helps to emphasise that data sharing is a positive act and that the shared data is a public good. There are successful examples of cooperation in Africa in this area such as UN Global Pulse (UN Secretary-General's initiative on big data and artificial intelligence for development, humanitarian action, and peace) and GSMA (e.g., Global System for Mobile Communications, the global industry organisation that represents the interests of mobile network operators).
- ✓ Develop common standards on and a joint understanding of the value of open data that can guide the public and private sector on how to provide better access to AI-ready datasets (see also UN Secretary-General's Roadmap for Digital Cooperation). Openly accessible AI training data stimulates economic growth by encouraging businesses to innovate on open data, generating competition, and promoting innovation in public services delivery.
- ✓ Facilitation of data partnership between public and private bodies.

Conclusion 7- Regional cooperation to attract global investment and accelerate AI adoption

In chapter 6 we proposed a roadmap for regional cooperation to shape joint policies, to create a data collaborative space and a common computing Infrastructure for Africa. In order to attract global investments and speed up the implementation of the proposed regional roadmap **we recommend** the following:

- ✓ Establishment of a common data protection regulation, which is a key precondition to mitigate risks associated with the use of AI and create cross-regional certainty for investors, with the goal of attracting global investments in Africa. African countries who have not put in place data protection legislation should make this a priority.



- ✓ Support for the development of regional clusters to promote cooperation and research.
- ✓ Establishment of joint regional AI investment funds with the participation of governments, industry and donors.
- ✓ Support for a common research agenda targeted towards AI.
- ✓ Engagement with international and bilateral donors on AI initiatives (e.g., World Bank, EC, GIZ).

Conclusion 8 – AI can play a role in addressing cross cutting issues

As a key technology, AI is not restricted to particular sectors or domains. As a result, it can address a number of cross-cutting issues:

- ✓ These may include the role AI can have to attract talents from the diaspora as well as mainstreaming gender equity and encouraging more women to become active part of the AI Ecosystem.
- ✓ In addition, AI can create positive traction among youth especially through grass root initiatives as well as promoting use cases that can light up the younger (e.g. sports, esports, art and culture).
- ✓ AI efforts in Natural Language Processing (NLP) can contribute to both strengthening local languages as well as reducing language barriers across the continent.

