

Policy Paper

Artificial Intelligence Revolution in Africa: Economic Opportunities and Legal Challenges

By Abdessalam Jaldi

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Artificial intelligence (AI) is playing an increasingly important role in our daily lives. Having experienced considerable growth in recent years, artificial intelligence corresponds to technologies capable of processing hybrid sources, particularly unstructured data. Complex tasks are thus delegated to increasingly autonomous technological processes, capable of driving economic and social development. In current African society, AI is becoming more popular and seeking to cover all facets of human activity. The adoption and use of these modern technologies in the African context are currently low because of some emerging challenges. These difficulties may have a direct influence on African economic development. In this paper, we highlight the opportunities and challenges facing the adoption of AI technologies in Africa.

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The Policy Center for the New South (PCNS) is a Moroccan think tank aiming to contribute to the improvement of economic and social public policies that challenge Morocco and the rest of Africa as integral parts of the global South.

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INTRODUCTION

Artificial intelligence, as a branch of science that studies and develops intelligent machines, is a significant component of the fourth industrial revolution that will lead to fundamental changes in the way people live, work, and relate to one another. PricewaterhouseCoopers AI sizing the prize report estimated that by 2030, AI technologies could increase the global economy by \$15.7 trillion (14%), with increased productivity contributing about \$6.6 trillion and consumption side-effects providing \$9.1 trillion.¹ The PWC report also showed that although AI is at an early stage of development, and the AI markets in Europe, North America, and China are more advanced than in other regions. To put this into perspective, the financial gains for the markets in Africa are estimated to be around \$1.2 trillion, while for China it is about \$7.0 trillion, \$3.7 trillion for North America, and \$1.8 trillion for Northern Europe. These figures indicate that in Africa, AI development and deployment are still in the early stages and face a number of challenges before AI can be a transformative force in society.

However, the nature of AI promises to bring about fundamental socio-cultural changes in Africa, including in areas such as political activities, poverty alleviation, environmental sustainability, transportation, agriculture, healthcare, education, financial transactions, and religious and traditional belief systems. Many of these AI systems are no longer described as dreams but are becoming a reality in Africa, though mainly driven by companies with roots in the Global North. In addition to the big technology companies establishing operations in Africa, home-grown experts are increasingly establishing technology spaces similar to the US Silicon Valley and Silicon Wadi in Israel. These tech spaces and many African networks, local AI start-ups, and local stakeholders are fostering a growing ecosystem aimed at developing AI systems that are sensitive to African interests, concerns, and culture.

Therefore, AI as a tool or system that performs a specific intelligent task (otherwise known as artificial narrow intelligence—ANI) is growing and thriving in Africa. However, despite the great benefits these AI systems promise for Africa, there are also substantial economic and legal challenges that undermine the adoption and implementation of AI across the continent. Furthermore, the benefits and risks of AI are as great as the risks, and its development may infringe on a number of fundamental rights and freedoms. This Policy Paper therefore aims to take stock of the current state of AI in Africa. It explores both the benefits and the limits of AI for the continent. It also proposes a legal framework for AI specific to African realities.

1. Africa and the AI Revolution

Over the next few years, Africa is set to see an acceleration in the deployment of artificial intelligence in a number of sectors. Based on a process of imitating human intelligence through the creation and application of algorithms, artificial intelligence has a promising future and represents a huge opportunity for the continent.

1.1 *The rise of AI in Africa*

Africa's tech boom is often linked to fintech, but the largest tech acquisition in the continent during the last years was AI-focused.² Indeed, AI tech is growing across Africa, with over 2,400 companies

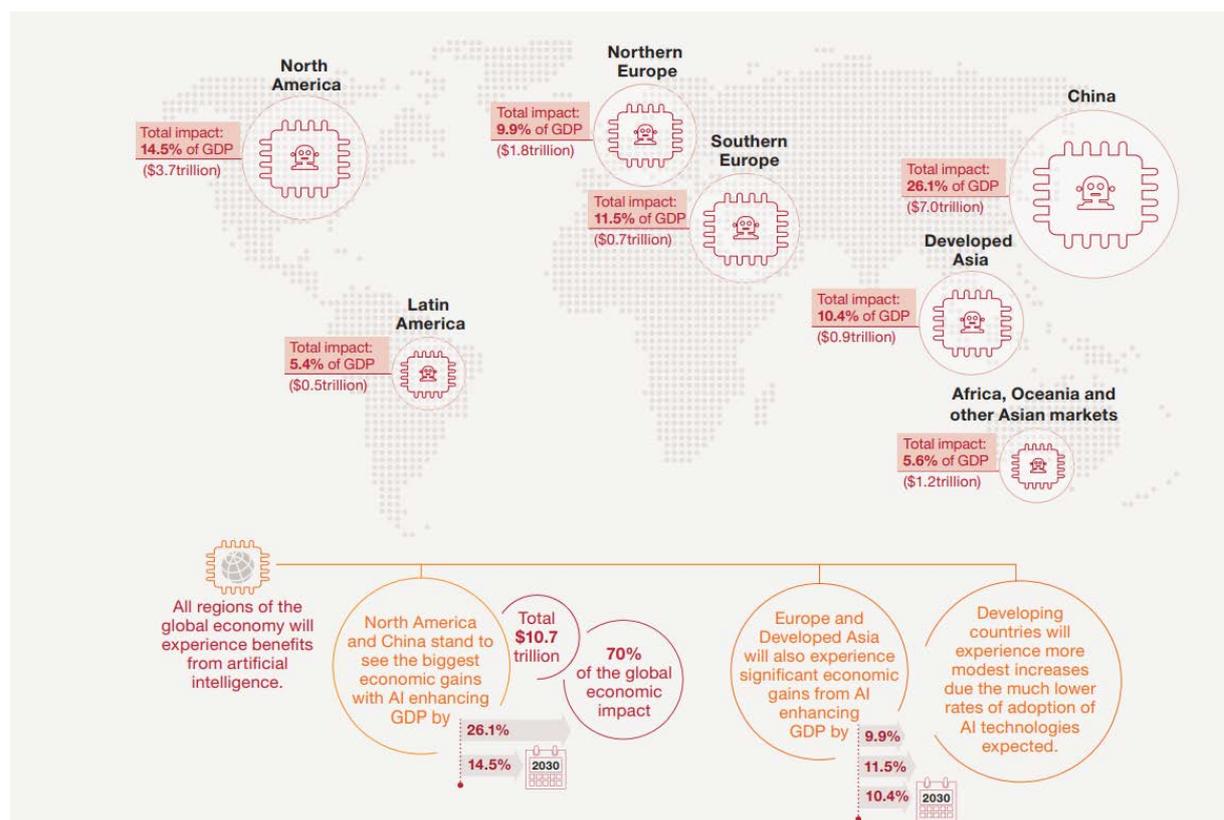
1. PricewaterhouseCoopers International Limited. Sizing the prize: PwC's Global Artificial Intelligence Study: Exploiting the AI Revolution What's the real value of AI for your business and how can you capitalise? Page 4. <https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf>

2. David I. Adeleke. Africa's role in the global AI race is more prominent than you know. 2023. <https://restofworld.org/2023/3-minutes-with-fatima-tambajang/#:~:text=support%20AI%20startups-,Africa's%20tech%20boom%20is%20often%20linked%20to%20fintech%2C%20but%20the,was%20acquired%20for%20%24682%20million.>

specializing in AI, 41% of which are startups. Estimates indicate that the technology could contribute \$1.2 billion to the continent’s GDP by 2030³, if it could only capture 10% of the fast-growing global AI market⁴. This configuration has contributed to the emergence of an AI ecosystem in Africa.⁵

1.1.1 AI Development in Africa

Figure 1



Source: PwC analysis

To stimulate the development of artificial intelligence industries on the continent, local and international AI research hubs have been established. South Africa leads the continent in AI adoption with a robust ecosystem⁶. An estimated more than 100 companies in South Africa are either integrating AI solutions into their existing operations or are developing new solutions using AI⁷. Women in Machine Learning & Data Science (WiMLDS) also have chapters in Algeria, Botswana, Kenya, Morocco, Nigeria, and Uganda, to engage with and promote women’s participation in AI.

3. Faustine Ngila. Africa is joining the global AI revolution. 2022. <https://qz.com/africa/2180864/africa-does-not-want-to-be-left-behind-in-the-ai-revolution>

4. Faustine Ngila. Africa is joining the global AI revolution. 2022. <https://qz.com/africa/2180864/africa-does-not-want-to-be-left-behind-in-the-ai-revolution>

5. Emmanuel Ogiemwonyi Arakpogun, Ziad Elsahn, Femi Olan and Farid Elsahn. Artificial intelligence in Africa: challenges and opportunities. Northumbria University Doha Institute for Graduate Studies. In: The Fourth Industrial Revolution: Implementation of Artificial Intelligence for Growing Business Success. 2021.

6. Aleksandra Gadzala Tirziu. Coming to life: Artificial intelligence in Africa. Atlantic Council. 2018. <https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/coming-to-life-artificial-intelligence-in-africa/>

7. Alexander Ferrein and Thomas Meyer. A Brief Overview of Artificial Intelligence in South Africa. AI Magazine. 99-101

WiMLDS is critical in amplifying the voice and input of women in the advancement of AI, given the concerns raised about the lack of diversity and gender bias in AI⁸. Furthermore, Both Google and IBM labs have engineered AI solutions to improve food production and healthcare across Africa. Given that most of the academic and industry research hubs that focus on AI are predominantly located in advanced and wealthy locations, such as Silicon Valley in California and Zhogguancun in Beijing, a recent shift to African countries is encouraging, and has led to the emergence of several start-ups across various regions in Africa⁹, raising over \$140 million in seed-funding¹⁰. In Nigeria for example, a chatbot called Kudi AI, which receives seed funding from the Silicon Valley incubator Y-Combinator, is among a growing number of AI-powered apps designed to extend financial services to underserved populations¹¹. In like manner, MomConnect, a chatbot initiated by South Africa's National Department of Health, connects an estimated 1.8 million expectant mothers with pre-and post-natal services. Registered women are able to chat with the app and receive healthcare advice relevant to their pregnancy¹².

African countries	Number of companies that specialize in AI
South Africa	726
Nigeria	456
Egypt	246
Kenya	204
Morocco	126
Ghana	115
Tunisia	103
Cameroun	54
Tanzania	44
Uganda	44
Zimbabwe	44
Mauritius	35
Ivory Coast	29
Algeria	26
Senegal	23
Rwanda	21
Zambia	20
Ethiopia	18
Botswana	16
Republic Democratic of Congo	10

8. John Feast. 4 Ways to Address Gender Bias in AI. Harvard Business Review. 2019.

9. Emmanuel Ogiemwonyi Arakpogun, Ziad Elsahn, Femi Olan and Farid Elsahn. Artificial intelligence in Africa: challenges and opportunities. Northumbria University Doha Institute for Graduate Studies. In: The Fourth Industrial Revolution: Implementation of Artificial Intelligence for Growing Business Success. 2021.

10. Ibid.

11. Aleksandra Gadzala Tirziu. Coming to life: Artificial intelligence in Africa. Atlantic Council. 2018. <https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/coming-to-life-artificial-intelligence-in-africa/>

12. Ibid.

Mohamed, says is thought to be a prelude to an official national AI strategy. Tunisia recently formed a dedicated countrywide Tunisian Association for Artificial Intelligence, as a Tunisian industry association focused on AI. One of its pioneering start-ups, Instadeep, in January 2023 closed the largest funding round of any African AI start-up, securing a series B investment of \$100 million¹⁷. Finally, with the inauguration of the AI Movement Center of Mohammed VI Polytechnic University in Rabat and the House of Artificial Intelligence in Oujda, Morocco has confirmed its determination to take part in the fourth industrial revolution. Since it launched the AI Khawarizmi program, with funding of €4.5 million in 2021, it looks to have been playing the role of regional locomotive in AI.

AFRICA IN 2022 AI INDEX RANKINGS

Mauritius	57
Egypt	65
South Africa	68
Tunisia	70
Morocco	87
Kenya	90
Rwanda	93
Seychelles	94
Nigeria	97
Botswana	98
Ghana	104
Benin	108
Algeria	111
Namibia	115
Senegal	116
Cabo Verde	118
Uganda	123
Tanzania	125
Gabon	127
Ivory-Coast	136
Cameroon	138
Djibouti	144
Togo	145
Zambia	146
Zimbabwe	148
Libya	149
Mauritania	150
Madagascar	152
Gambia	153

17. Faustine Ngila. Africa is joining the global AI revolution. 2022. <https://qz.com/africa/2180864/africa-does-not-want-to-be-left-behind-in-the-ai-revolution>

Guinea	155
Sao Tome and Principe	156
Mali	157
Congo	158
Burkina Faso	159
Lesotho	160
Eswatini	161
Ethiopia	162
Angola	163
Sierra Leone	164
Malawi	165
Comoros	166
Niger	167
Guinea Bissau	168
Sudan	169
Mozambique	170
Liberia	171
Chad	172
Burundi	173
Democratic Republic of the Congo (DRC)	174
Eritrea	175
Central African Republic	176
South Sudan	177

1.1.2 AI at African Continental and Regional Levels

The main African continental-level instrument with relevance to the African Union (AU) is the AI for Africa Blueprint, developed in 2021 between the AU and SmartAfrica¹⁸. It is an African AI strategy that outlines the opportunities and challenges of AI in the region and proposes key principles and pillars for inclusion in any continental and regional AI strategy. By outlining a framework for artificial intelligence in Africa, the Blueprint is a massive step forward by the AU towards rights-based regulation of AI, with the aim of guaranteeing African AI sovereignty. In the same vein, the African Commission on Human and People's Rights, recently adopted Resolution 473¹⁹, calling on national governments, the AU, and other fora to work towards developing legal and ethical frameworks to govern AI and emerging technologies. At regional level, the Economic Community of West African States (ECOWAS) adopted the 2010 Supplementary Act on Personal Data Protection within ECOWAS, which is binding on the community's member states²⁰. Other African regional economic

18. SmartAfrica. Blueprint. Artificial Intelligence in Africa. 2021. https://www.bmz-digital.global/wp-content/uploads/2022/08/70029-eng_ai-for-africa-blueprint.pdf

19. Oxford Insights. Government AI Readiness Index. 2022. https://www.unido.org/sites/default/files/files/2023-01/Government_AI_Readiness_2022_FV.pdf

20. Faustine Ngila. Africa is joining the global AI revolution. 2022. <https://qz.com/africa/2180864/africa-does-not-want-to-be-left-behind-in-the-ai-revolution>

bodies have also worked to produce non-binding instruments with relevance to AI—e.g. the East African Community’s (EAC’s) draft EAC Legal Framework for Cyber Laws, and the Southern African Development Community’s (SADC’s) Model Law on Data Protection in 2012²¹.

1.1.3 Africa’s Alignment with International Standards on AI

At global level, UNESCO convened a Forum on Artificial Intelligence in Africa in Morocco in December 2018. In its Outcome Statement, the forum called for, inter alia, the AU, in partnership with the African regional economic communities (RECs), to develop a continental strategy for AI, which includes digital data management, and which should be based on a multi-stakeholder approach and underpinned by the AU Agenda 2063²². Subsequently, in November 2019, at UNESCO’s 40th General Conference, member states mandated the UNESCO Director-General to prepare an international standard-setting instrument on the ethics of AI in the form of a recommendation²³. In fulfilment of that mandate, UNESCO assembled an Ad Hoc Expert Group (AHEG) to prepare the draft text of the recommendation, which was published in November 2021 as UNESCO’s Recommendation on the Ethics of Artificial Intelligence²⁴. Adopted by all 193 member states, the framework outlines a series of values, principles, and actions to guide countries in the formulation of legislation, policies, and other instruments related to AI²⁵. The non-binding recommendations address issues around transparency, accountability, surveillance, data protection, the environment, social scoring, and more. The recommendation also noted the need for governments and tech firms to build AI technologies that protect and promote human rights and fundamental freedoms. In this context, to guide the development of ethical AI, the recommendation outlines 10 principles, including safety and security, fairness and non-discrimination, proportionality and ‘do no harm’, sustainability, transparency and explainability, and awareness and literacy, backed up by more concrete policy actions on how they can be achieved. For example, the recommendation strongly promotes the use of ethical impact assessments as a way of making sure that developers and deployers of the technology take account of the wider socio-economic impacts of their systems, including in terms of data protection and human rights. The recommendation also calls on member states to implement strong enforcement mechanisms and remedial actions, so that any harm caused by an AI system can be effectively dealt with. The recommendations also outline how AI systems should and should not be deployed: *“Member states should introduce incentives, when needed and appropriate, to ensure the development and adoption of rights-based and ethical AI-powered solutions for disaster risk resilience; the monitoring, protection and regeneration of the environment and ecosystems; and the preservation of the planet (...) in particular, AI systems should not be used for social scoring or mass surveillance purposes”*²⁶. The recommendation further stresses that, when developing regulatory frameworks to inhibit the potential for social scoring or mass surveillance, member states must ensure that ultimate responsibility always lies with a human being, and that no AI technologies should ever be given legal personalities themselves.

21. Randy Onuoha. AI in Africa: Regional data protection and privacy policy harmonisation. In Association for Progressive Communications (APC), Article 19, & Swedish International Development Cooperation Agency (Sida) (Eds.), Global information society watch 2019: Artificial intelligence: Human rights, social justice and development.

22. UNESCO. Outcome statement of the forum on artificial intelligence in Africa. 2018. https://en.unesco.org/sites/default/files/ai_outcome-statement_africa-forum_en.pdf

23. UNESCO. 40th Session of the General Conference – 12–27 November 2019. <https://en.unesco.org/generalconference/40>

24. United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO’s Recommendation on the Ethics of Artificial Intelligence: key facts. <https://unesdoc.unesco.org/ark:/48223/pf0000385082>

25. Ibid.

26. United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO’s Recommendation on the Ethics of Artificial Intelligence: key facts. <https://unesdoc.unesco.org/ark:/48223/pf0000385082>

1.2 AI as an Economic Opportunity for Africa

AI technologies are an opportunity for Africa to accelerate productivity and reimagine its economic growth, which is, more than ever, vital for the welfare of the world. This section describes active areas of AI research and innovation poised to make beneficial impacts in the near term for Africa. Most solutions currently target the employment, food security, healthcare, and energy sectors.

1.2.1 Employment

On Employment, for example, Samasource has employed young people across Kenya and Uganda to train data and transmit human intelligence to AI for big-tech companies including Google, Microsoft and Yahoo²⁷. Over 1100 young people are working on various projects across Kenya and Uganda with incomes that support, for example, the education of their siblings and overall living conditions of their families, to the extent that over 50,000 people are now benefitting from this process²⁸. The dependable income generated in the process also increases the purchasing power of people, which then helps them to gradually break the endemic cycle of poverty²⁹. For a country like Kenya with disproportionately high levels of youth unemployment of over 30%, despite a growing literacy rate, the jobs created by Samasource are critical to improving the quality of life and maintaining social cohesion in Kenya³⁰. However, and to better anticipate the impact of AI on jobs in Africa, it is important to consider the distribution of the labor force³¹. Approximately 54% of all workers in sub-Saharan Africa are in the agricultural sector, and in some countries this figure surpasses 70%³². In the agricultural sector, AI has two primary uses that are, or are expected to be, of significant impact and value³³. First, as with other sectors, AI has significant advantages in analyzing data, and it is thus useful for predicting the weather, optimizing planting and harvesting schedules, determining appropriate fertilizer needs, and the like³⁴. This use of AI has the potential to increase yields and overall land productivity or efficiency, and it is unlikely to negatively affect the African labor force in the agricultural sector³⁵. Indeed, by improving the ability to predict floods and drought, optimize land usage, and increase yields, AI may increase the need for workers in the agricultural sector³⁶. This use of AI is, therefore, not necessarily competitive with human labor, and could actually be complementary to it.

27. Emmanuel Ogiemwonyi Arakpogun, Ziad Elsahn, Femi Olan and Farid Elsahn. Artificial intelligence in Africa: challenges and opportunities. Northumbria University Doha Institute for Graduate Studies. In: The Fourth Industrial Revolution: Implementation of Artificial Intelligence for Growing Business Success. 2021.

28. Ibid.

29. Ibid.

30. Ibid.

31. Arthur Gwagwa, Erika Kraemer-Mbula, Nagla Rizk, Isaac Rutenberg, Jeremy de Beer. Artificial Intelligence (AI) Deployments in Africa: Benefits, Challenges and Policy Dimensions. The African Journal of Information and Communication. Number 26. Page 10. 2020.

32. Fuglie, K., Gautam, M., Goyal, A., & Maloney, W. F. (2019). Harvesting prosperity: Technology and productivity growth in agriculture. World Bank.

33. Walch, K., How AI is transforming agriculture. 2019 Forbes. <https://www.forbes.com/sites/cognitiveworld/2019/07/05/how-ai-is-transforming-agriculture/#3a8a51ed4ad1>

34. Arthur Gwagwa, Erika Kraemer-Mbula, Nagla Rizk, Isaac Rutenberg, Jeremy de Beer. Artificial Intelligence (AI) Deployments in Africa: Benefits, Challenges and Policy Dimensions. The African Journal of Information and Communication. Number 26. Page 10. 2020.

35. Ibid

36. Ibid

1.2.2 Food Security

Food insecurity is a major concern across Africa³⁷, from the Sahel region to the Horn and Southern Africa. In 2022 alone, over 656 million people in sub-Saharan Africa (SSA) suffered from food insecurity³⁸. While about 65% of global arable uncultivated land is situated in Africa, its governments collectively spend nearly billions dollars in term of importing food. Furthermore, the locust outbreak in the Horn of Africa in 2020 destroyed over \$8 billion worth of food and livestock³⁹. However, the impact of food insecurity in Africa could be mitigated with the use of AI technologies. Crop diseases and disasters could be predicted, and farmers forewarned for better preparation. It is also useful to bear in mind that agriculture in the continent is a strategic sector that needs improvement across Africa, and AI should be a critical part of the solution. Indeed, this sector, which accounts for 32% of GDP, employs over 65% of the continent's labor force⁴⁰. However, the sector faces numerous challenges, including the degradation of land, increased dependence on inorganic fertilizers, weak supply chains, limited markets for the produce, emerging pests and diseases, and climate change. However, despite the potential of AI to improve agriculture in Africa, it is still unavailable outside governmental and research bodies. This is why Google AI lab has collaborated with farmers in rural Tanzania to create a machine-learning application called 'Nuru' (meaning light in Swahili) to diagnose early stages of cassava plant diseases for the advancement of the production of a common staple crop that provides food for over 500 million people⁴¹. Nuru works directly on farmers' cellphones, even without internet connectivity, and warns them to take early intervention measures by quickly identifying and managing cassava plant diseases, which, in turn, helps to maintain consistent food production. In the same vein, in South Africa, several AI start-ups are solving African agricultural problems. For example, MySmartFarm, Aerobotics, Drone Clouds, and FarmDrive are AI-enabled technologies developed in South Africa to address agricultural issues including plant disease diagnosis, price prediction, marketing, expert consultation, and access to financial services⁴².

1.2.3 Healthcare

Over the past three decades, dominated by the 'Washington Consensus', social protection issues have been relegated to the backburner. However, numerous studies show that a universal social protection system is the fundamental basis for inclusive development. Consequently, Africa should invest in artificial intelligence technologies to strengthen its social protection systems and health resilience. This effort is particularly necessary to reduce the burden of the informal economy and to increase the productivity of African workers. In the context of delays in the reporting of cancer diagnoses in South Africa as a result of the manual and unstructured pathology process, IBM Research pioneered a machine-learning system to automate the process and cut the reporting time from four to two years. The reduction of the reporting process offers invaluable information for the government to formulate national health policy and take timely decisions that would save lives. While South Africa is among the two countries in Africa (the other being Mauritius) that

37. Ehui, S. Protecting food security in Africa during COVID-19. Retrieved from The Brookings Institution, 2020. <https://www.brookings.edu/blog/africa-in-focus/2020/05/14/protecting-food-security-in-africa-during-covid-19/>

38. Holger Kray, Shobha Shetty, Pierre-Olivier Colleye. Trois défis et trois chances pour la sécurité alimentaire en Afrique de l'Est et australe. Banque mondiale Blogs. 2022. <https://blogs.worldbank.org/fr/africacan/trois-defis-et-trois-chances-pour-la-securite-alimentaire-en-afrique-de-lest-et-australe>

39. Broom, D. Millennials are transforming African farming. Retrieved from World Economic Forum. 2019. <https://www.weforum.org/agenda/2019/06/the-millennials-giving-african-farming-an-image-boost/>

40. Ibid.

41. Arakpogun, E. O., Wanjiru, R., & Whalley, J. Impediments to the implementation of universal service funds in Africa – A cross-country comparative analysis. Telecommunications Policy, 41(7-8), 2017, 617-630.

42. African Union Development Agency (AUDA). AI for Africa : Artificial Intelligence for Africa's Socio-Economic Development. APET Report.

meets the minimum World Health Organization's (WHO) recommendation of 23 healthcare workers per 10,000 people⁴³, the country is still struggling to provide adequate healthcare to its citizens. Overall, access to healthcare in many African countries is acute. AI solutions like those engineered by IBM Research and other AI start-ups in Africa could be a 'game-changer', as the use of machine-learning systems and mobile phones can facilitate remote diagnosis and treatment for millions across Africa, particularly those living in remote and rural areas.

1.2.4 Energy

Africa's energy systems face enormous challenges because of limited African capacity in electricity generation and experience. Consequently, Africa experiences the most acute forms of energy poverty in the world. It is estimated that over 630 million people across Africa live without reliable access to electricity and affordable modern cooking fuels, particularly in sub-Saharan countries, where a widening gap in electricity access remains problematic. However, the poor interconnection of national electricity grids has a massive impact on economic growth, including in countries such as Nigeria and South Africa. In this context, AI technologies may be felt also in the areas of the traditional industries of oil, gas, and electricity. According, David G. Victor, three clusters of impacts seem most likely to affect energy and climate, particularly in the African context: two will alter the supply and demand for energy, and one will affect the abilities of societies to understand how emissions are affecting the climate and how to manage those impacts⁴⁴.

First, most visible in the energy and climate space is the impact of AI on how energy is supplied. That's because more intelligent energy-supply systems, in effect, shift outward the supply curves⁴⁵. For example, machine-learning systems can improve the ability to map and understand the size and value of underground deposits of oil and gas, making it easier to tap into those resources at lower cost. The same logic also applies to renewable energy. For example, AI-assisted training for the design and operation of wind and solar farms can make these systems much more efficient in how they take financial resources and generate electricity⁴⁶.

Second, one of the great promises of adding AI to energy markets lies with linking what customers want with the exact range of options and market conditions for supplying those energy services⁴⁷. Machine learning is ideally suited for making fine-grained determinations of what customers want and then adjusting energy purchasing decisions accordingly⁴⁸. In theory, machine learning could make a number of services that are already offered in today's market more powerful, such as: purchasing green energy credits (AI could better embed information about what customers are willing to pay for green energy and also offer different shades of green), and adjusting power purchasing decisions (as power grids shift to play a much larger role for variable renewable generators, the price of power will become more variable, creating greater social value from real-time adjustments in power purchasing)⁴⁹. In this context, AI can allow even small consumers to

43. Jayaram, K., Leke, A., Ooko-Ombaka, A., & Sun, Y. S. Finding Africa's path: Shaping bold solutions to save lives and livelihoods in the COVID-19 crisis. Nairobi: McKinsey & Company. 2020.

44. David G. Victor. How Artificial Intelligence will affect the future of energy and climate. Brookings. 2019. https://www.brookings.edu/articles/how-artificial-intelligence-will-affect-the-future-of-energy-and-climate/?fbclid=IwAR15mXfPvRdJS4dLEtU4-rT2YQnFuXB_qsluGw9-IQpLbj9ef6xbNO8wQ_w

45. David G. Victor. How Artificial Intelligence will affect the future of energy and climate. Brookings. 2019. https://www.brookings.edu/articles/how-artificial-intelligence-will-affect-the-future-of-energy-and-climate/?fbclid=IwAR15mXfPvRdJS4dLEtU4-rT2YQnFuXB_qsluGw9-IQpLbj9ef6xbNO8wQ_w

46. Ibid.

47. Ibid.

48. Ibid.

49. Ibid.

automatically adjust their power consumption in real time with prevailing prices. AI can also help make electricity supplies more reliable and tailored to consumer needs (AI schemes could integrate data from hazards and then adjust grid operations accordingly, making the grid safer, more efficient, and more reliable)⁵⁰.

Third, most human-caused changes in climate are rooted in how we use energy, in particular fossil fuels that, when combusted, generate carbon dioxide (CO₂). In this context, AI could help radically improve the assessment of climate change⁵¹. Today's climate impact assessments rely on global-scale models of the climate system that are then downscaled to regional and local assessments⁵². The downscaling process is complex and imperfect, in part because multiple local factors affect how broad changes in the climate are manifested where people actually live, along coastlines, near wildfire zones, in cities struggling with heat stress, and the like⁵³. AI makes it possible to connect the imperfect downscaling process with real information about actual impacts, reflected in insurance claims, weather extremes, the arrival of migrants, and observed outbreaks. AI could help automate and enrich that process, making feasible real-time adjustments to climate-impact assessments⁵⁴.

2. The Limitations of AI in Africa

While AI has the potential to accelerate Africa's economic transformation, it also raises concerns about the risks it poses. For the purposes of our study, we will focus on the economic and legal limits of artificial intelligence in Africa.

2.1 *Economic Limits of AI*

Many AI specialists have expressed concerns that the evolution of AI and other technological advancements could result in a series of unintended economic consequences. Broadly speaking, these concerns include the amplification of existing structural inequalities, and business and work disruptions.

2.1.1 **Digital Inequalities**

Similar to the disproportionate structural inequalities, African countries also lag behind other parts of the world when it comes to bridging digital divides. In the same vein, the development of AI involves machine learning and NLP processes, which consist of complex algorithms; thus, programming skills are needed⁵⁵. However, AI skills are more difficult skills to master, and there is undoubtedly a demand–supply imbalance in the market⁵⁶. It must be said that in developing markets such as the African market, a scarcity of AI-ready workers is a major issue⁵⁷. This means that lack of digital literacy is a significant barrier to the adoption and implementation of AI in Africa. It should be noted that out of all world regions, sub-Saharan Africa has the lowest percentage of

50. Ibid.

51. Ibid.

52. Ibid.

53. Ibid.

54. Ibid.

55. Abejide Ade-Ibijola and Chinedu Okonkwo. *Artificial Intelligence in Africa: Emerging Challenges*. Social and Cultural Studies of Robots and AI (SOCUSCRA). 2023. Page 195.

56. Ibid.

57. Ajadi, S. Can AI help tackle the most pressing challenges in developing countries? GSM Association. 2020. <https://www.gsma.com/mobilefordevelopment/region/africa/can-ai-help-tackle-the-most-pressing-challenges-in-developing-countries/>

citizens equipped with digital skills, equal to about half of the average level of digital skill take-up seen globally. In 2022, the average score of the 46 sub-Saharan African countries included in the IA index was 29.38, the lowest globally.⁵⁸ The region is overrepresented at the bottom of the ranking spectrum, with 21 out of the 25 lowest scores belonging to sub-Saharan African countries⁵⁹, and the region scores particularly low in the Technology Sector pillar, with an average score of 20.96. The same report gives the average score for North Africa as 38.59 points against 29.38 points for sub-Saharan Africa⁶⁰. The scores of the two regions are thus below the world average score of 44.61 points⁶¹. The impression is that the digital divide in Africa is symptomatic of deeper issues, with existing inequalities transferred into the digital space with the consequence of poor AI readiness. High levels of structural inequality and digital divides⁶² also highlight a major lack of government preparedness for AI in African countries. No country in the continent ranks among the top-50 positions. Therefore, there is a correlation between structural inequalities, digital divides, and AI readiness, meaning that the most disadvantaged would also miss out on AI opportunities including employment, improvement in education and healthcare, and access to e-government services. It is also necessary to say that the lack of investment by African governments into infrastructure necessary for supporting digital economies has hampered the growth of digital literacy.⁶³

2.1.2 Business and Work Disruptions

According to Klaus Schwab, who introduced the 4IR concept, a common concern among business executives is that the acceleration of innovation and the velocity of disruption in the 4IR are hard to understand, even for the best connected and most well-informed⁶⁴. Similarly, there is evidence across Africa that the advancement of AI is beginning to challenge and underpin business models and processes. For example, over 70% of CEOs in South Africa have acknowledged the need to increase AI investment to boost competitiveness and productivity⁶⁵. However, only about a third of these organizations are planning significant AI investments⁶⁶. This further underlines the huge AI funding gap between Africa and the rest of the world. Low levels of AI investment would result in low adoption for businesses operating across Africa, making it very challenging to leverage the opportunities offered by AI. Furthermore, the evolution of AI could lead to the displacement of workers as automation could substitute human labor⁶⁷, as symbolized by the Chatbot application. This would lead to wage stagnation or increase unemployment as the importance and negotiating power of labor becomes weak. This could increase the income gaps between the high-skilled and low-skilled workers, which could exacerbate structural inequalities. For instance, the continuous emergence of artificial intelligence technologies has resulted in an increased demand for highly skilled workers, while the demand for low-skilled workers has not experienced a similar growth.

58. Oxford Insights. Government AI Readiness Index. Palgrave MacMillan. 2022. https://www.unido.org/sites/default/files/files/2023-01/Government_AI_Readiness_2022_FV.pdf

59. Ibid.

60. Ibid.

61. Ibid.

62. Rutenberg, I. Africa. In O. Insights, Government Artificial Intelligence Readiness Index 2019 (pp. 9-11). 2019. Oxford: Oxford Insights and Canada's International Development Research Centre (IDRC).

63. World Bank. (2020) Digital Skills for all African Students: What Will it Take? 28 Feb. Available at: <https://www.worldbank.org/en/news/feature/2020/04/14/digital-skills-for-all-african-students-what-will-it-take> (Accessed: 9 June 2021).

64. Emmanuel Ogiemwonyi Arakpogun, Ziad Elsahn, Femi Olan and Farid Elsahn. Artificial intelligence in Africa: challenges and opportunities. Northumbria University Doha Institute for Graduate Studies. In: The Fourth Industrial Revolution: Implementation of Artificial Intelligence for Growing Business Success. 2021.

65. Ibid.

66. Ibid.

67. Ibid.

including those with less education, has decreased. Scholars have highlighted the dangers of automation in terms of the erosion of labor market and industrial policies in sub-Saharan Africa, and have called for stronger institutions to enforce and protect workers' rights⁶⁸.

2.1.3 Lack of Structured Data Ecosystem

AI initiatives rely on the quality and quantity of data contents to provide accurate information or responses to users in each situation.⁶⁹ In many cases, an AI will fail if the data that is used to train the AI system does not reflect the demographic variables in the targeted population.⁷⁰ A Chatbot system, for example, requires comprehensive information about its operations to provide correct responses to users; if the information requested by the user is not in the data bank, the system will fail.⁷¹ Data shortages in Africa are well known in the context of development, where high-quality data are essential indicators of growth in relation to the Sustainable Development Goals (SDGs) and a key input for the development of modern technologies.⁷² The UN Economic Commission for Africa (UNECA) stated that African data ecosystems are at *"nascent stages of the African data revolution and the private sector is increasingly becoming a critical and dynamic player within African data ecosystems"*.⁷³ Machine learning methods are only as good as the data they are given. AI algorithms include prejudices found in data or even in the individual who created the process, spreading social disparities.⁷⁴ This is especially important in Africa, where users are more likely to import machine learning algorithms built and trained abroad using data that may not recognise or be biased against substantial parts of the African population.⁷⁵ To enable researchers, developers, and users to adopt AI solutions, a deeper, larger, and more accessible pool of data is needed. In developing markets, particularly in unstable or conflict-affected areas, high-quality data is not always available or accessible.⁷⁶

On the other hand, another issue plaguing the effective adoption of artificial intelligence in Africa is the lack of data accessible to African researchers and the relevance of this data to African problems in domains such as agriculture, health care and voice/text recognition.⁷⁷ As explained above, Machine learning relies on vast amounts of data to train algorithms, and if this data is sparse and unrepresentative, the resulting algorithms will be less effective and could cause harm to the vulnerable populations.⁷⁸ Within Western countries, issues regarding dataset representation of minority populations like Black people and women have gained prominence over the past few years.⁷⁹ However, this conversation has continued to stay focused on dataset bias in the context of Western issues, centring the gaze of these problems on the Global North. In regions where

68. Gaus, A., & Hoxtell, W. *Automation and the Future of Work in Sub-Saharan Africa*. Berlin: KonradAdenauer-Stiftung. 2019.

69. Damian Okaibedi Eke, WaKutoma, Simisola Akintoye. *Responsible AI in Africa : Challenges and Opportunities Social and Cultural Studies of Robots and AI*.

70. Ibid.

71. Ibid.

72. Damian Okaibedi Eke, WaKutoma, Simisola Akintoye. *Responsible AI in Africa : Challenges and Opportunities Social and Cultural Studies of Robots and AI*.

73. Ibid.

74. Ibid.

75. Kathryn Hume, *Artificial Intelligence is the future—But it's not immune to human bias*, Maclean's, 2017.

76. Komarova, N., Zamkovo, A., Novikov, S. *The fourth industrial revolution and staff development strategy in manufacturing*. *Russian Engineering Research* 39, 2019. 330–333.

77. Damian Okaibedi Eke, WaKutoma, Simisola Akintoye. *Responsible AI in Africa : Challenges and Opportunities Social and Cultural Studies of Robots and AI*.

78. Ibid.

79. Buolamwini, J. *Gender Shades*. 2018. <http://gendershades.org/>

the social construct of race is not present, focusing solely on the lack of racial representation in datasets limits how people address other facets of dataset underrepresentation in the Global South.⁸⁰ Expanding issues of dataset bias to factors like ethnicity, tribal affiliations and other cultural nuances will help datasets become truly inclusive and relevant to solving African challenges.⁸¹ This stresses the importance of local communities within the African continent being involved in the creation, sharing and use of datasets.⁸²

2.2 *The Growing Use of AI Undermines Fundamental Rights and Freedoms*

Numerous studies have shown that AI undermines fundamental rights and freedoms, including the right to privacy and personal data protection, freedom of movement, the right to work, the right to health, and the right to education. Only infringements of the principle of non-discrimination, freedom of expression, and the dilemma of regulation will be discussed in this section.

2.2.1 **Non-Discrimination**

The principle of non-discrimination is enshrined in Article 2 of the African Charter on Human and Peoples' Rights. While the use of AI is often explained by the neutrality of this technology, in reality this neutrality is only an appearance. On the face of it, this recourse would make it possible to escape the prejudices and unconscious discrimination carried out by every human being, since decisions are no longer made by a human being endowed with an opinion, but by a machine. However, we mustn't forget that this machine has been imagined and shaped by a human being. During the creation of artificial intelligence, human beings inevitably conceive of this technology with their own prejudices, whether conscious or unconscious. So, right from the start, AI inherits a bias from its creator.

According to a U.S. National Institute of Standards and Technology Study, a facial recognition system is between 10 and 100 times more accurate at identifying people of African-American or Asian origin than it is at identifying people of Caucasian origin⁸³. For this study, the researchers relied on over 18 million photos in total, representing around 8.5 million people, and used by 189 facial recognition algorithms. A mistake made by facial recognition software can be very damaging, especially if such a technique is used by law-enforcement agencies: it could lead to false accusations or arrests. American legal tech Palantir, for example, has been developing and testing predictive policing tools since 2012 in cities including Chicago, Los Angeles, New Orleans, and New York⁸⁴. Predictive policing is the act of predicting that an offence will be committed at a specific location, or predicting whether a suspect is likely to commit an offence. The use of AI as a predictive policing tool can be seen as a benefit to society as a whole, as it would enable more effective prevention and repression of crime, but it does present a real risk to individual freedoms. These technologies are also being tested in Africa, but predictive policing tools do not draw up 'suspect cards' and focus on places where an offence is likely to be committed.

In the field of justice, AI makes it possible to speed up the processing of huge quantities of data

80. Damian Okaibedi Eke, WaKutoma, Simisola Akintoye. Responsible AI in Africa : Challenges and Opportunities Social and Cultural Studies of Robots and AI.

81. Ibid.

82. Ibid.

83. New York Times. Many Facial-Recognition Systems Are Biased, Says U.S. Study. 2019. <https://www.nytimes.com/2019/12/19/technology/facial-recognition-bias.html>

84. Odhran James McCarthy. AI & Global Governance: Turning the Tide on Crime with Predictive Policing. United Nations University – Center for Policy Research. 2019. <https://cpr.unu.edu/publications/articles/ai-global-governance-turning-the-tide-on-crime-with-predictivepolicing.html>

and to determine the length of prison sentences, enabling more homogeneous approaches to comparable cases. Nevertheless, the use by American judges of the COMPAS artificial intelligence algorithm to determine an individual's probability of recidivism has raised controversy in the U.S. In 2016, an investigation by the NGO ProPublica concluded that the data used by the COMPAS algorithm was biased, and therefore so was the algorithm, to the detriment of individuals from minority backgrounds⁸⁵. If these breaches of the principle of non-discrimination continue, there is a risk of reducing confidence in the application of the law following the use of artificial intelligence, and thus compromising the rule of law.

The use of AI in Amazon's recruitment software produced similar results. In 2014, the e-commerce giant developed a computer program to automate the recruitment process for its employees. However, Amazon had to give it up three years later because the software discriminated against women. The software's objective was to assign a rating from one to five stars based on the candidate's profile. To do this, the AI was based on the profiles of Amazon candidates over a 10-year period. Because of the predominance of men in the field of new technologies over this period, the AI deduced that male profiles were to be favored, to the detriment of profiles mentioning the word 'female' or 'feminine'⁸⁶. Consequently, AI thus reinforces discrimination by embedding it in technology. In response to this, the NGOs Amnesty International and AccessNow drafted the Toronto Declaration. This text, published on May 16, 2018, aims to protect the right to equality and non-discrimination in systems based on machine learning⁸⁷.

2.2.2 Freedom of Expression

Freedom of expression is enshrined in Article 9 of the African Charter on Human Rights. However, AI is regularly used, notably by social networks, to control the content posted by their users. This technology will identify content that does not comply with the platform's terms of use. Governments putting pressure on companies to tackle the problem of terrorist content, hate speech, and fake news have led to increased use of automated systems. Germany's NetzDG law, for example, requires social networks to delete a large amount of content between 24 hours and seven days after it has been reported⁸⁸. However, since AI is imperfect, and social networks are under pressure to remove unwanted content quickly, some content may be deleted by mistake. For example, YouTube deleted over 100,000 videos documenting atrocities committed in Syria after they were flagged for 'inciting hatred'. Yet these videos were often the only evidence of the crimes and human rights violations committed in that country: artificial intelligence failed to distinguish these violent videos, for which YouTube makes exceptions because of their educational and documentary value, from violent videos for propaganda purposes⁸⁹. In France, the Avia law, inspired by the German NetzDG law and providing for an obligation for social networks to remove illegal content within 24 hours, was censured by the Constitutional Council on June 18, 2020, for fear of infringements on freedom of expression⁹⁰.

AI Regulation

85. Julia Angwin, Jeff Larson, Surya Mattu and Lauren Kirchner. Machine Bias: There's software used across the country to predict future criminals. And it's biased against blacks. ProPublica. 2016. <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing>

86. Les Échos. Quand le logiciel de recrutement d'Amazon discrimine les femmes. 2018. <https://www.lesechos.fr/industrie-services/consolidation/quand-le-logiciel-de-recrutement-damazon-discrimine-les-femmes-141753>

87. Déclaration de Toronto. <https://www.torontodeclaration.org/declaration-text/francais/>

88. BBC. Germany starts enforcing hate speech law. <https://www.bbc.com/news/technology-42510868>

89. Le Point. Syrie : quand YouTube supprime des vidéos témoignant de la guerre. 2017. https://www.lepoint.fr/monde/syrie-quand-youtubesupprime-des-vidéos-temoignant-de-la-guerre-23-08-2017-2151784_24.php

90. Quentin Hugon. La loi Avia contre la haine en ligne largement retoquée par le Conseil constitutionnel. Le Monde. 2020. https://www.lemonde.fr/pixels/article/2020/06/18/le-conseil-constitutionnel-censure-la-disposition-phare-de-la-loi-avia-contre-la-haine-en-ligne_6043323_4408996.html

Finally, AI governance and regulation also face challenges. The fusion of multiple technologies underpins the architecture of AI and its ability to drive the 4IR. This fusion is accelerating technology convergence in a manner that poses a new challenge to governments, particularly in the realms of regulation. It is argued that the institutional capacity of governments to regulate previous industrial revolutions was less challenging given the propinquity between the speed of public policy decision-making and the linear mechanistic process that existed. Accordingly, governments had more time to formulate relevant regulatory frameworks to set the rules of engagement, using limited capacity to govern the industry. However, with the fast-moving pace of modern technology, coupled with constant convergence, regulation becomes increasingly challenging, complex, and expensive for governments⁹¹. The general lack of institutional capacity and AI regulatory frameworks across Africa could result in unintended consequences, including the inability of governments to guarantee the data security and privacy of citizens, and the undermining of cyber and national security. While the threats to cybersecurity have been around since the 3IR, the advancement that comes with AI and IoT further complexify personal and national security, because critical and life-saving devices are wirelessly tethered together⁹². One implication of this is that state or individual actors could cripple critical infrastructure in a manner that threatens the existence of a nation. As technological advancement like AI develops, it heightens the threat levels to cybersecurity; this should also shift how governments respond to safeguard societies. Therefore, the paucity of comprehensive AI policy frameworks that are relevant to the African context is deeply concerning⁹³.

3. Africa Needs to Regulate AI

The emergence of the legal concept of artificial intelligence has been hampered by a lack of scientific consistency, and its foundations and contours need to be clarified. At a time when the fourth industrial revolution is taking hold and the individual is venturing into a deterritorialized world, the protection of digital rights and freedoms must be based on clearly identified and reaffirmed legal principles, and on a wide range of regulatory tools. Judges have a major role to play, alongside specially competent independent authorities and civil society.

3.1 The Need for More Transparent AI

Despite the infringements of fundamental rights and freedoms, the technological advance represented by AI should not be dismissed. Indeed, according to Salil Shetty, former Secretary General of Amnesty International, *“there are immense opportunities and benefits to be gained from artificial intelligence if human rights are at its core”*⁹⁴.

To develop artificial intelligence while limiting its impact on fundamental rights and freedoms, the first objective is to ensure an effective remedy that individuals can use to assert their rights. Article 8 of the Universal Declaration of Human Rights, as well as Article 13 of the European Convention on Human Rights, in the context of the European legal order, state that the right to an effective remedy in the event of violation of fundamental rights and freedoms is an imperative. In France, for example, there is such a remedy, the (*référé liberté* in French), provided for in article L. 521-2 of

91. Janssen, M., Brous, P., Estevez, E., Barbosa, L. S., & Janowski, T. (2020). Data governance: Organizing data for trustworthy Artificial Intelligence. *Government Information Quarterly*.

92. Wilner, A. S. Cybersecurity and its discontents: Artificial intelligence, the Internet of Things, and digital misinformation. *International Journal*, 2018. 73(2), 308-316.

93. Emmanuel Ogiemwonyi Arakpogun, Ziad Elsahn, Femi Olan and Farid Elsahn. Artificial intelligence in Africa: challenges and opportunities. Northumbria University Doha Institute for Graduate Studies. In: *The Fourth Industrial Revolution: Implementation of Artificial Intelligence for Growing Business Success*. 2021.

94. Forbes. Comment préserver les droits de l'homme face à l'intelligence artificielle et aux robots ? 2017. <https://www.forbes.fr/technologie/comment-preserver-les-droits-de-lhomme-face-a-lintelligence-artificielle>

the Code of Administrative Justice. This procedure exists within the administrative court, and can be initiated under three conditions: it is necessary to show urgency, to show that a fundamental freedom is at stake, and to show that the infringement of this freedom is serious and manifestly illegal.

Secondly, the European Commission's White Paper on Artificial Intelligence explained that *“the peculiarities that characterize many AI technologies, notably opacity (‘black box effect’), complexity, unpredictability and partially autonomous behavior, can make it difficult to verify compliance with the rules of EU law in force designed to protect fundamental rights, and can hamper the monitoring of their application”*⁹⁵. Algorithms therefore need to be more transparent, so that the solutions they propose can be better understood, someone can be held responsible for these decisions, and they can be more easily contested. Reverse engineering, the science of deciphering a machine's reasoning, is essential to increasing the transparency of artificial intelligence tools.

Thirdly, Alternative Dispute Resolution (ADR) can be an alternative to the courts for resolving digital disputes. ADR processes have a number of advantages. They are flexible, cost-efficient, time-effective, and give the parties more control over the process and the results. Parties who resolve their disputes through ADR are generally more satisfied because they may participate directly in working out the terms of their settlement. On the other hand, when appropriate settlement processes are available, many disputes can be resolved more efficiently and with greater satisfaction to all parties. Lengthy, costly litigation can be avoided, divisiveness minimized, and productive results achieved. Finally, cooperation between governments, private companies, academics, NGOs, international organizations, and citizens could lead to the development and use of AI that is more respectful of fundamental rights and freedoms. Raising people's awareness of AI, from an early age, is also essential to ensure that everyone makes good use of these technologies and understands their influence on our lives.

3.2 *The Need for More Responsible AI*

With the widespread use of AI in everything from autonomous cars and precision medicine to predictive maintenance and air traffic management, a new issue is emerging: liability in the event of damage caused by artificial intelligence. By liability, we mean the obligation of an individual to compensate for harm caused to others. The primary function of tort law is to compensate the injured party for the damage suffered. The second function of tort law is preventive. The obligation on those responsible to compensate for the damage they cause encourages everyone to behave with diligence. On the other hand, liability law is not intended to punish those responsible. This punitive function belongs to criminal law.

African legal systems, like other international legal systems, do not provide a clear answer to this question. AI is an immaterial entity with no legal personality or assets, so it cannot be held responsible for its actions. As a result, and because artificial intelligence is immaterial (software), but embedded in machines (hardware), it is difficult to extract its specific behavior beyond the action it co-commands with man. However, its growing autonomy (co-learning) will make it increasingly independent of human action. From this point of view, the legal framework for artificial intelligence systems—which does not restrict innovation, but provides effective protection for potential victims—is of considerable importance. However, this objective requires a balanced legal framework. In this respect, several avenues have been proposed, including the creation of an electronic personality, giving artificial intelligence systems (AIS) a legal status, following the example of limited companies during the first industrial revolution. The case of Saudi Arabia, which granted citizenship to the robot ‘Sophia’ in 2017, with a status comparable to that of human beings, can inspire Africa. This

95. European Commission. https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_fr.pdf

machine can move and interact with its environment without the active intervention of a human being, although Sophia lacks consciousness and no real autonomy.

Nevertheless, only a truly autonomous AI, endowed with self-awareness that enables it to reason, understand what it is doing, and make choices, merits the granting of legal personality. In other words, an AI capable of wilfully causing harm, and totally beyond the control of human beings, must be granted legal status, in order to impose on it the burden of reparation for the harm caused. However, this form of AI does not yet exist, and so the creation of an electronic personality is not yet necessary. It seems more reasonable to attribute the effects of liability to the designer, manufacturer, owner and user of AI, who are hidden behind the machines. However, in order to determine which of these players is liable in the event of damage caused by AI, it is essential to promote the transparency of the algorithms used. This presupposes the implementation of a system enabling the reasoning of the algorithm to be traced, so that attributing the harmful result to an individual is possible.

CONCLUSION

Industrial AI can be the foundation of digital transformation and business innovation of Africa, leading to a new stage of growth and advancing African industries and technologies. AI systems will be taking decisions that affect the future of Africa. However, The adoption of AI technologies in Africa faces challenges, including lack of technical skills, uncertainty, lack of structured data, lack of government policies, ethics, and user attitudes. As the capabilities for autonomous decision-making grow, perhaps the most important issue to consider is the need to rethink responsibility. Being fundamentally tools, AI systems are fully under the control and responsibility of their owners or users. However, their potential autonomy and capability to learn meant that design should consider accountability, responsibility, and transparency principles in an explicit and systematic manner. The development of AI algorithms has so far been led by the goal of improving performance, leading to opaque black boxes. Putting human values at the core of AI systems calls for a mind-shift among researchers and developers, towards the goal of improving transparency rather than performance. This could lead to novel and exciting techniques and applications. In particular, this requires complementing the currently predominant individualistic view of AI systems, with one that acknowledges and incorporates collective, societal, and ethical values at the core of the design, development, and use of AI systems.

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