

# Artificial Intelligence as a Path Way to Africa's Transformations

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**Abstract—** Artificial Intelligence (AI) has become an indispensable tool in this technological evolutionary age; we cannot afford to let go of its vital contributions to humanity. AI has created the platform that drives countries' economic growth, improvement of healthcare, food security via agriculture production, transport, manufacturing facilitation, poverty reduction, and the like. Likewise, Africa AI giants like Kudi, Aerobotics, Apollon Agriculture, Datavora, and UTU Technologies had made significant artificial intelligence advances.

Nevertheless, mass AI adoption and its role in the technological transformation in most African countries by the various government are in a stagnant position with little or no hope of improving. The panicle pivotal question that we ask is, "What does AI mean for Africa?". In this study, we aim to evaluate African's development in the field of AI and its impacts on the industrial revolution of the continent. Furthermore, we employ a content analysis technique via a case study approach to unravel the significance of the research. The study advocates the essence of AI's contribution to health, agriculture, business, and all other sectors of the economy. The study proposes recommendations that will facilitate AI deployment in Africa.

<p><b>Keywords—</b>Artificial Intelligence, Machine Learning, Agriculture, Fintech</p>	<p>Intelligence, Learning, Africa,</p>	<p>Human Africa,</p>
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## I. INTRODUCTION

Andrew Ng, a leading Artificial Intelligence (AI)-focused computer scientist and entrepreneur at the AI Frontiers Conference, exclaimed that "AI is the new electricity." He elaborated on this statement by further stressing that "Just as electricity transformed almost everything 100 years ago, today, I have a hard time thinking of an industry that I don't think AI will transform in the next several years" [1], [2].

Artificial intelligence (AI) has vast potential to facilitate Human Intelligence (HI) and revolutionize how people utilize products and services, acquire information, create products, and interact [3]. [4]

highlighted in its report that by 2030, AI would increase the world's Gross Domestic Product (GDP) to 15.7 trillion, a forecasted \$6.6 trillion to productivity and \$91.1 trillion to consumption effect. AI has progressed from an academic subject to a vital element in social and economic mainstream technologies such as banking, medical diagnostics, self-driving cars, and voice-activated machines that enhance people's daily life [5]. Google Maps, Uber and Lyft rides, Facebook suggestions, spam filters in email, online shopping, and cancer detection are just a few examples of AI technology that has made life easier [6]. Businesses are competing to become AI corporations because of the incredible speed with which AI is invading every industry [7].

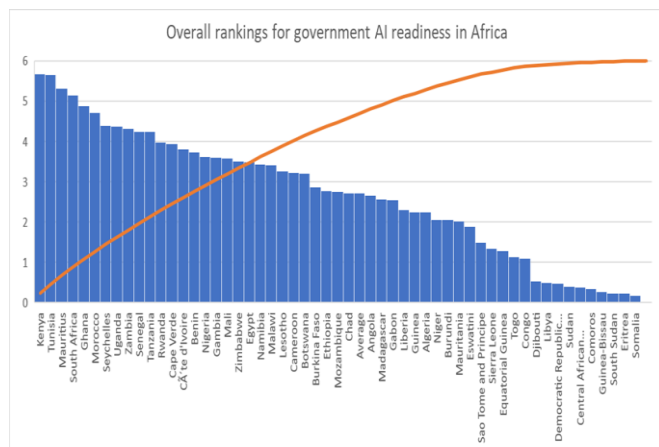
Moreover, AI and Machine Learning (ML) are rapidly evolving and transforming developing economies' political, economic, and social landscapes. As a result, AI-based solutions are expected to emerge as a game-changer with significant consequences for increasing financial access to the poor [8]. In Africa, AI has helped solve some local problems; for example, an AI chatbot system monitors sexual and reproductive health in Kenya [1]. Also, there is an intelligent farming system in Nigeria where AI-powered drones monitor and track illegal fishing [1]. AI provides many opportunities and dramatically contributes to a broad range of Sustainable Development goals (SDGs), including poverty reduction, educational quality for all, portable water and sanitation, affordability and clean energy, and peace and justice strong institutions [9]. However, the more significant impact of AI has been felt on continents such as Europe, Asia, North America, etc., but its effect is hardly seen in African. Lack of diversity in AI could perpetuate unanticipated algorithmic biases and create discrimination in AI products, particularly in Africa [10]. The disparity in the number of AI researchers implies that there will be fewer opportunities to apply AI to better Africans' lives [10]. [11] stated that people do not think of efficient utilization of AI and robotics application on the African

continent due to the high degree of poverty and unemployment. Scholars such as

[12] report on the readiness of the AI index revealed that the African continent was scored among the lowest regions on average because of few countries' readiness to implement AI as part of their countries' policy.

Figure 1 indicates African government AI readiness index report ranking from [12]. Countries like Kenya, Tunisia, Mauritius, South Africa, and Ghana were ranked among the top five countries regarding government readiness to AI. The report's focus was based on how governments can position themselves to take advantage of AI-powered transformation. Thus, how AI can transform healthcare, education, and transportation in these countries. Kenya was ranked first on the Africa continent but globally was ranked 52nd position with a score of 5.672 [12]. [13] postulated that Africans must create technologies that consider Africa's socio-economic and infrastructure realities to develop AI solutions to meet the continent's most pressing demands.

This calls for studies to evaluate African's development in the field of AI and its role in the technological transformation of the continent. Our analysis adopts a content assessment to elaborate on the African AI development path. We used the case study of the top 5 leading AI firms in Africa in our discussion to provide an overview of how these AI firms impact the lives of citizens on the continent. The researchers also offer some global challenges of AI and delve much into some barriers to AI in Africa. Finally, some policy recommendation has been suggested which when keenly followed by heads of states in Africa and policymakers can lead to the industrial revolution on the continents.



## 2.0 History and Definition of AI

To achieve the objectives of this study, the researchers first took an overview of the history and definition of AI, the development of AI, future trends of AI, and the landscape of AI in Africa. AI had its roots in 1950, when Alan Turing, an English polymath, devised a test to see if a machine could portray HI [14], giving the rest of the world a glimmer of the

possibilities that may emerge when computational processing capacity improves. John McCarthy and colleagues in 1955 developed the word "artificial intelligence," and it has been around for about 50 years. According to McCarthy et al. (1955), AI is the study of breaking down intelligence elements into simple stages that may be described or coded. As a result, AI can address well-defined, isolated problems one at a time, yet faster than humans [15], [16]. Evolutionary computation research has reached a pinnacle in recent years, with an increasingly stable research community focusing on the subject [17]. Another aspect of AI is Deep Learning (DL) which can be described as "the machine's capacity to improve its performance without relying on humans to tell it how to complete all of the jobs at hand.", [18]. AI can be described as "the study and design of computer programs that behave intelligently," as cited in research conducted by [19].

Likewise, [20] enunciated that AI is a group of technologies that enable robots to function intelligently, sense, comprehend, and act in the same way humans do. Thus, AI enables robots to sense their surroundings, reason about them, and, in some instances, learn to act in response to the environment and conditions in which they find themselves. Table 1 presents some recognized definitions of AI in literature review works by various authors on AI. As AI systems get more sophisticated, they find a more excellent range of business applications.

Table 1: Fundamental definition of AI from literary works

Citation	Key Definition
[22]	"The study of having machines execute things that would require intellect if done by humans is known as artificial intelligence."
[23]	"AI demonstrated by computers that exhibit features of HI is being more widely used in service and is now a significant driver of innovation."
[24]	"AI is a term used to denote systems that replicate cognitive functions such as learning, communication, and problem-solving that are generally associated with HI."
[25]	"AI has continuously been to create machines that were capable of thinking like humans."
[26]	"AI is defined as a branch of computing focused on the development of systems that can be instructed or learned to make predictions in particular situations."
[27]	"AI is characterized as the capacity of a system to comprehend and learn from external data independently to achieve certain goals through flexible adaptation."
[28]	"Artificial intelligence uses computers and technology to simulate the human mind's problem-solving and decision-making abilities."
[29]	AI is the ability of robots to accomplish cognitive activities that are similar to those performed by humans. Manipulation and movement of items, sensing and perception, problem-solving, decision-making, and innovation are all examples of physical tasks that can be automated.
[30]	The purpose of AI is to develop intelligent entities that portray human intelligence. Knowledge representation and reasoning, vision, language abilities, and machine learning are the key topics of AI.

## 2.1 AI Development

[31] reported that Deep Learning (DL), and Deep Neural Network (DNN) that excels at image or voice recognition, natural language processing, and prediction techniques, has risen to prominence in AI research recently. Symbolic AI was the dominating paradigm among AI development methodologies until DL began [32]. It is assumed that high-level knowledge representations (symbols) and symbol associations can attain human-like AI through thinking like how individuals communicate their thoughts and draw conclusions through deductive reasoning [33]. Google has recently deployed symbolic AI algorithms to display the most relevant and valuable information through AI in their business model [31]. According to [19] the next stage of AI development will focus on cognitive intelligence, which will more closely mimic how the HI learns, understands, and makes decisions and actions. In the coming years, greater computing power will dramatically boost data processing capability. Each industry's business model will be disrupted by AI, resulting in massive market prospects. DL has become a popular method with improved computer power and larger datasets, and it has surpassed prior approaches in picture categorization [34].

Research conducted by [33], [35] provides more details about Neural AI. In recent times, DNN has been getting more attention in industry and academia. The human brain network structure is made up of connections between distinct neurons. An artificial neural network (ANN) is a system that mimics the human brain and can perform classification and pattern recognition tasks [36], [37]. Netflix, Spotify, and Amazon use ML algorithms to provide customized suggestions. Neural AI is built on higher layers of the artificial neural network (ANN) as part of ML, allowing it to solve more intricate without significant hand-based preprocessing [38], [39]. Although AI is currently focused on various tasks in restricted domains, the notion of mimicking all aspects of HI remains unresolved.

## 2.2 AI Future Trends

Researchers agree that the combination of symbolic AI and neural AI seems to be very promising for the future of AI [41], [42]. A new approach for integrating symbolic AI and neural AI is implementing logic tensor networks [41]. Over the past few decades, AI has evolved, and a lot of impressive progress of very parameter-rich have been achieved through DNN and DL [43]. With the changing demands of people, business and government, there is the need to incorporate new knowledge of AI to these needs. The focus of current AI is based on big data. In today's digital interactions, enormous amounts of organized and unstructured data in various formats, including audio and video, are frequently encountered. As a result, new tools and strategies for dealing with "big data" have emerged [44].

Industry 4.0, which encompasses cloud computing, the Internet of Things (IoT), robotics, and automation, will have a more substantial influence on future developments of AI. ML and other analytics approaches can analyze data from IoT devices [40]. ML and AI are a growing trend in many firms, particularly software corporations like Google and Facebook, as part of Industry 4.0 [45]. The ultimate hypothetical goal of AI in the future is to achieve superintelligence (ASI), which is considerably superior to that of even the most brilliant and gifted HI [46]. According to most experts, AGI, or Artificial General Intelligence, is expected to arrive in roughly 20 years [47]. AGI is the ability of computers to stand pair with HI. Some researchers believe the year will be 2030, while others think it will be in the second half of this century. Superintelligence is projected to emerge quickly due to artificial general intelligence's recursive self-improvement, as depicted in Figure 1 [46].

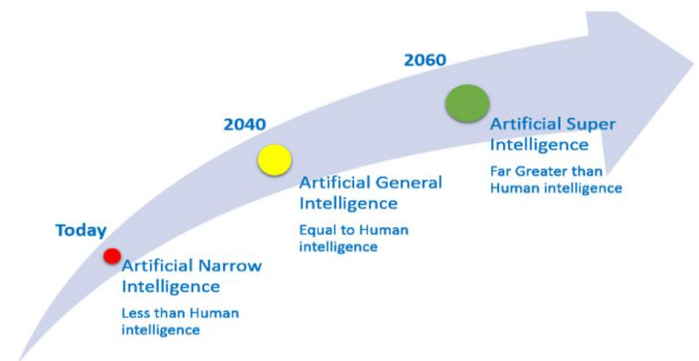


Figure 1: Future of AI Source: Adapted from [46]

## 2.3 Landscape of AI in Africa

The population of Africa is rapidly increasing, with most of the people being at a young age. Africa's youth population is predicted to triple to 225 million by 2055. Africa will be home to three of the world's most populous cities: Lagos, Nigeria, with 88 million people; Kinshasa, Democratic Republic of Congo, 83 million; and Dar Es Salaam, Tanzania, with 73 million [48]. African countries are under pressure to offer services to fast-growing urban areas while simultaneously improving their performance on persistent poverty, political instability, and a host of security issues such as organized crime and political violence. AI has been suggested as a possible solution [48].

Therefore, there is the need to build the younger generation's capacity by equipping them with the requisite skills that can enable them to contribute to the continent's development. Developing the youth with AI techniques can lead to the industrial revolution on the continent. AI can allow Africa countries to harness their natural resources and raw material to better the livelihood of the citizens. Statista, 2017 report indicates that the Middle Eastern Africa market of AI from 2016 to 2025. The report shows that the AI market in the Middle Eastern Africa market is expected to increase from 2016 to 2025, as indicated in Figure 2. For instance, in 2022, it is estimated that



the AI market in Middle Eastern Africa to reach more than \$500 million US dollars.

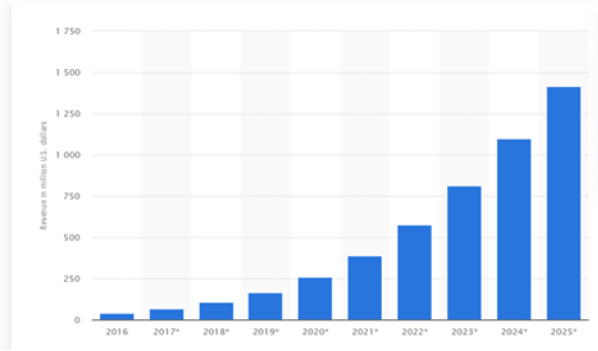


Figure 3: Middle Eastern Africa market of AI from 2016 to 2025 Source: [49]

Africa has come far with AI application, and some successes have been chopped over the years for which it is wealth recommendable. A startup based in Nigeria uses signal processing and ML to improve the diagnosis of birth asphyxia in low-resource environments. In Zambia [50], the findings of a study in which AI was employed to identify people with diabetes were substantial and encouraging compared to human assessments. Google's AI Lab in Accra, Ghana, is working on compression algorithms that can run on the CPU capabilities of mobile phones [51]. Nigerian farmers now have access to AI-based on-demand tractor access due to IBM's mobile open-source Hello Tractor technology [52]. Although Africa is considered the next technological boom after Asia, constraints such as controlled entry and competition, new economy skills access, and responsible institutions have prevented Africa from fully exploiting the benefits. The question that needs to be answered is What does AI means for Africa? To answer this question [20] suggested that AI would improve the lives of African in the health, Education, public service, education, food production and assist disabled person as depicted in Figure 2.

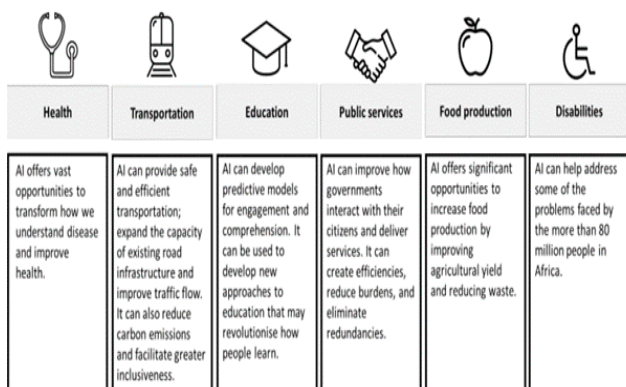


Figure 2: Benefits of AI to Africa Source: [20]

### 3.0 Case Study: Leading AI players in Africa

In this section, the researchers discuss some top AI firms in diverse sectors contributing to Africa's development. The list in Table 2 consists of firms in Fintech, Big Data, Chatbot, and AgTech. [53] ranked these AI giants as the top 10 leading organizations in Africa. A case study of the top 5 of these firms has been discussed to glimpse how these AI giants impact Africa's development in diverse ways. Table 2 indicated the top 10 leading AI giants in Africa.

Table 2: Top 10 Leading AI Firms in Africa

Organization	Application	City	Country	Funding USD (Million)
Kudi	FinTech	Lagos	Nigeria	5.9
Aerobotics	AgTech	Cape Town	South Africa	4.8
Apollo Agriculture	AgTech	Nairobi	Kenya	1.6
Datavora	Big Data	Tunis	Tunisia	0.9
UTU technologies	Big Data	Nairobi	Kenya	0.25
Botme	Chatbot	Cairo	Egypt	0.10
KiaKia	FinTech	Abuja	Nigeria	0.05
WideBot	Chatbot	Cairo	Egypt	0.05
Touchable Pictures	Image Recognition	Port Harcourt	Nigeria	0.002
GotBot	Chatbot	Johannesburg	South Africa	0.018

Source:[53] Note: Fintech: Financial Technology; AgTech: Agriculture Technology

Following are major Africa's AI giants that are working in the diverse fields of artificial intelligence.

#### 3.1 Case Study #1: Kudi

Kudi was founded in Nigeria, Lagos, in 2016 by young entrepreneurs Yinka Adewale (Cofounder, CEO) and Pelumi Aboluwarin (Cofounder, CTO). "Kudi" is a local dialect in Nigeria that means "money," and it was ranked the first AI company in Africa [53]. Kudi's network of bank agents bridges the gap between the cash economy and digital solutions in Nigeria, where 80 percent of the population is paid in cash. Money transfers, bill payments, and cash withdrawals are just a few of the essential banking services provided by Kudi [54]. The mission of Kudi is to make financial services accessible to Nigerians and Africa as a whole.

Kudi collaborates with commercial banks and other financial service providers to deliver various financial products to small informal enterprises and individuals, such as deposits, loans, and insurance. The exciting aspect of this Fintech enterprise is introducing AI Chatbot that enables customers to make financial transactions. As a result, Kudi has created a bill payment and money transfer chatbot with Skype and Facebook Messenger [53]. Kudi just secured \$5 million

to grow its network of bank agents in Nigeria. This was a game-changer, allowing Kudi to create a network of over 4500 merchants since its launch in January 2017 and generate over \$30 million in monthly income [54]. Figure 3 shows how transactions take place on the Kudi platform through chatbot with customers.

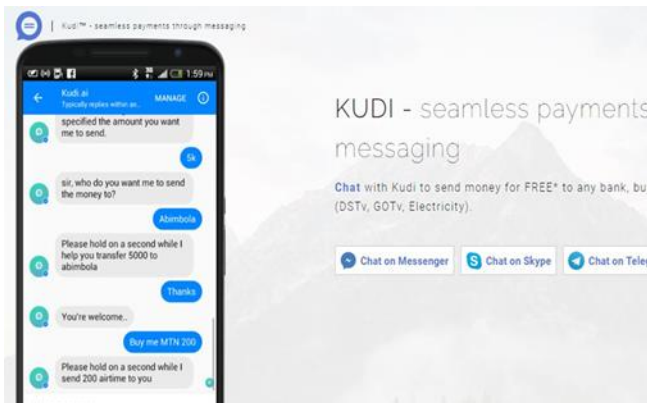


Figure 2: Sample of Kudi Payment Platform

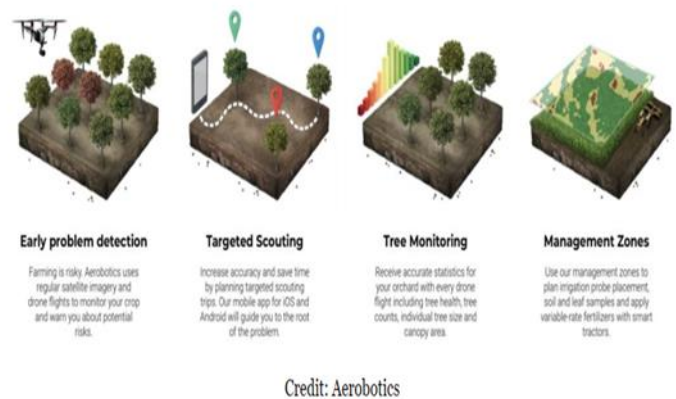
Source: [53]

#### Case Study #2: Aerobotics

In Africa, agriculture has been a backbone for many economies. The investment that Aerobotics through AI is contributing to help improve agriculture on the continent is quite recommending. Aerobotics was founded in South Africa (Cape Town) in 2014 to provide farmers with the opportunity to make more informed decisions. Thus, Aerobotics provides farmers with a more integrated approach to farm management and crop protection through AI. James Paterson and Benji Meltzer merged their expertise in aeronautics and ML to discover solutions to the agriculture industry's problems in South Africa. Aerobotics employs AI by using drones and other robotics to track and access crop health, including recognizing sick trees, pest tracking and disease prevention, and yield management analyses. The company has advanced its system by gathering and analyzing tree and fruit footage from farmers and now provides farmers with independent and reliable output estimates and harvest timings. Farmers may then organize their inventory, estimate demand, and ensure that their consumers receive the best possible supply.

Aerobotics secured \$600,000 in a seed round in 2017 from 4Di Capital and Savannah Fund. In 2019, the company raised an additional \$4 million in Series A funding from Nedbank Capital and Paper Plane Ventures. Aerobotics was selected as one of the 20 most promising Afrikan digital startups for the XL Africa residency, the flagship initiative of the World Bank Group's infoDev program, which began in April 2016

[55]. Some of the advantages and benefits of using Aerobotics are shown in Figure 4.



Credit: Aerobotics

Figure 3: Some of the characteristics and advantages of adopting Aerobotics

Source: [56]

#### Case Study #3: Apollo Agriculture

Eli Pollak, Benjamin Njenga, and Earl St Sauver created Apollon Agriculture in Nairobi, Kenya, in 2016. Apollon Agriculture's primary goal is to assist farmers in emerging markets in increasing their yields and profits. Apollon achieves this goal by helping farmers secure loans, high-quality farm inputs, and personalized guidance using ML, remote sensing, and mobile technology. Apollo uses ML algorithms to give customized seed, fertilizer, and even tips on how to grow better crops based on satellite data, soil data, farmer behavior, and crop yield estimates. Farmers may buy high-quality seeds and fertilizer with flexible post-harvest repayment terms thanks to Apollo Agriculture. Apollo Agriculture's goal is that small farms may triple their output by following a comprehensive plan while also providing financial education to Kenyan farmers underbanked [53]. Apollo Agriculture secured \$6 million from Series A Funding to provide financial support to farmers in Kenya [57]. Over 40,000 Kenyan farmers benefit from Apollon Agriculture [58]. Agri-Business Capital Fund (ABC Fund) recently gave the company \$1 million to help small-scale farmers gain the tools they need to enhance their profits [59].

#### Case Study #4: Datavora

In July 2016, Aymen Ferchichi, Hedi Zaher, and Oussama Messaoud founded Datavora in Tunis, Tunisia. Datavora technology, which monitors e-commerce websites, distributor data, online marketplaces, and brand portals, provides product assortments, exposure, displayed prices, and other analytical information on an easy-to-use dashboard. As a result, the system aids businesses in making critical decisions by providing information on pricing positioning for a particular brand verse the competition, main competitors for specific product lines, and the

most popular product lines [60]. Datavora has built an automated monitoring system for e-commerce to deliver high value to their consumers' decision-making processes. Datavora uses 13 technology tools and services, including HTML5, Google Analytics, and jQuery. Also, Datavora is actively employing 42 technologies on its website [61]. Datavora raised US\$500,000 in a seed funding round from investors such as United Gulf Financial Services - North Africa (UGFS), two Tunisian investment funds, as well as family, friends, and coworkers. The funds were utilized to advance the company's technology and provide clients with a unique value proposition to offer them a competitive advantage [60].

**Case Study #5: UTU Technologies**

Utu Technologies was founded in 2017 by Bastian Blankenburg, Jason Eisen, Polina Kazak, and Ronald Mahondo in Kenya Nairobi. UTU means "humanity" in Swahili, a local dialect in Kenya [62]. The goal of UTU Technologies is to create a platform that recommends service providers based on people's social media connections. It can be described as a "trust infrastructure" to empower service providers in sectors where consumers have trust issues such as teaching, babysitting, IT development, and home maintenance. Also, UTU is developing the internet's trust infrastructure to make it easier, safer, and more trustworthy for businesses and consumers to engage and transact [53].

Utu uses an AI-powered platform to gather and analyze data to generate trust signals and customized recommendations that assist consumers and companies in making the best decisions possible. In addition, the UTU blockchain technology promotes users for their trustworthiness and compensates them for sharing their data while maintaining their anonymity. UTU aims to find out who you know and then see who they can recommend, effectively creating a form of word of mouth without the need to interact or connect with anyone [62]. The UTU taxi service uses Trust Infrastructure As a Service (TIAS) to let users book cabs throughout the city based on suggestions from other platform users. Over 100000 connections have been made on their platform in Nairobi alone, with 96 percent of clients choosing highly-rated drivers over socially suggested drivers [63].

**4.0 Challenges of AI**

**4.1 Global Challenges of AI**

The implementation of AI differs from the application of older technologies and presents a new set of obstacles. These difficulties stem from various causes, including the changing nature of the business environment, the nature of AI and ML, and the limitations of underlying information theory, which apply to all information processing but are especially pertinent to AI [64]. Globally, the implementation of AI is affected by some challenges. Table 3 provides a list

of some of the barriers listed from existing literature pieces.

**Table 3: Scope of AI Challenges**

AI Challenges	Details	Citations
Social	Cultural Barriers, Human Rights, unrealistic expectation towards AI, lack of innovation and drive force	[64]–[67]
Political, Legal, and Policy	Copyright issues, government autonomous intelligence system, privacy safety, responsibility, and accountability	[66], [70]–[72]
Data Quality	Lack of data to validate benefits of AI solutions, dimensionality obstacles, insufficient size of the available data pool, lack of standards for data collection, format, and quality	[65], [66], [73]–[76]
Managerial and Organizational	Realism of AI; Better understanding of needs of the health systems; organizational resistance to data sharing, lack of in-house AI talent, the threat of replacement of human workforce	[64], [66], [68], [76]
Technological	Adversarial attacks; Lack of transparency and interpretability; design of AI systems; AI safety; specialization and expertise; big data; architecture and lack of ability to read unstructured data.	[68], [73], [77]–[83]

**4.2 Barriers to implementing AI in Africa**

Even though Africa has already begun its AI journey, hurdles linger. The most challenging impediment is the lack of fundamental and digital infrastructure, slowing down efforts to deploy AI. Some obstacles to the implementation of AI in Africa include;

**4.2.1 Data Desert/ Data Quality**

The fundamental usefulness of AI will not be found in, say, a neural network or an algorithm. It will instead be found in how data intelligence transforms the business. The quality and quantity of data available will determine AI's performance and capacity to assemble and make sense of data from various sources, including IoT devices and social media. [75], stated that the restricted availability of data and its quality and quantity could pose a hurdle to AI's potential. [74] emphasized that the idea of AI is based on the data-quality program in place. Therefore, in Africa, one key challenge to AI is the availability of quality data that can be accessed.

Africa lacks quality data – that is, data that is refined and reliable. This scarcity of accessible data can make deploying efficient AI solutions difficult in Africa. There is no clear regulatory framework in most African countries to control the proper use of AI. There are not enough stringent laws and regulations to safeguard African citizens from such outcomes in the



IT industry, leaving customers open to data manipulation and privacy breaches.

#### 4.2.2 Ethical Challenges

Various research works have discussed AI and its ethical implication on the privacy of users. According to research conducted by [66], individuals and companies lack trust and concern about AI and the utilization of shared information or data. Discrimination issues have been one key challenge to most African countries. [84] suggested that AI systems may occasionally display discrimination, even if human decision-making is not involved in the looping and algorithm process. However, because machines can approach humans and objects in comparable situations differently, research is beginning to reveal some worrisome examples of algorithmic decision-making that fall short of our expectations. As a result, specific algorithms run the risk of duplicating and even intensifying human biases, especially those that affect vulnerable populations [37]. With mass, facial recognition applications that might be exploited and have significant privacy and human rights implications, it appears that video, news, and social media could become mass influencing instruments with potentially destabilizing repercussions if used for malicious ends [85].

#### 4.2.3 Human capital, education, and skills

While access to AI upskilling and training is expanding, many Africa countries still lack a consistent supply of homegrown talent and professional AI developers. In many nations, the lack of mentorship accessible to startups creating AI-based solutions is also a barrier. Furthermore, AI talent in Africa is in short supply. Due to a lack of educational financing and infrastructure in some nations, they may not import AI talent or impart AI expertise to their populace [85]. The establishment of a road map to gather additional financial and human resources, including what has been dubbed a "pan-African AI fund" to assist such efforts, is a critical step in supporting the future of AI in Africa. An excellent illustration of this would be the augmentation of AI institutes to collect and maintain knowledge, technologies, and talent throughout the continent. Policymakers and governments might benefit from such networks, which could also serve as a beneficial collaboration tool for the private sector [86].

#### 4.2.4 Automation and the risk of job losses

Uncertainty and fear, especially when it comes to comprehending the function of AI and robotics, can be hurdles to adoption. Employees may be fearful about losing their employment or resistive to change. Change management is crucial within organizations to guarantee that AI is successfully implemented [87]. According to a Microsoft and EY survey, 83 percent of South African enterprises interested in using AI want to use it for automation. However, the number of jobs lost to AI could be compensated by investments in new skills needed for the latest employment that the

technology will create, with 96 percent of local businesses expecting "significant financial benefits" from using AI to improve their operations [88].

#### 4.2.5 Infrastructural Challenges

Economic transformation is critical to developing a nation with its foundation based on an efficient and effective infrastructure. However, Africa's infrastructure gap is up to \$108 billion per year [89]. African governments are faced with high costs, directly financing 42 percent of all infrastructure needs from national budgets. Artificial intelligence (AI) will catalyze for African countries to build their economy, alleviate poverty, and improve the lives of their citizens; however, these benefits have not yet been attained due to inadequate AI infrastructural development in Africa [89].

### 5.0 AI: A Path Way to Africa's Transformation

AI implementation in the developed world has proven to be a reliable force to enhance their development. As a result, this study highlighted the following strategies that can be used to promote AI adoption in Africa;

#### 5.1 Education

To begin with, the African educational system must be appropriately arranged to follow the STEM curriculum application such as Science, Technology, Engineering, and Mathematics. Africa can develop more in AI and its technologies by developing the creativity and analytic ability of the youth. The educational curriculum should focus on science, technology, engineering, and mathematics (STEM). African state institutions should also offer funding in the STEM and ICT sectors to encourage domestic research and application and ensure that disadvantaged students have equitable access to advanced technical education. [90].

#### 5.2 Government Support

Various governments in Africa must be transparent and conform to worldwide ethical values when implementing innovation activities through smooth regulation. The government policymakers should boost innovation and improve data protection, research, and development of AI applications. Kenya, Ghana, South Africa, Ethiopia, and Nigeria are the most aggressive and advanced countries working towards the efficient and effective utilization of AI. As expected, they are enjoying the fruit of their investment [91]. Furthermore, the government must establish an AI ecosystem responsible for ensuring the availability of infrastructure that houses high-quality data for its citizens [13]. [10] further urged African countries to create a unified legal framework and norms to ensure that AI is used in humanity's best interests.

#### 5.3 Creating Enabling Environment

Various heads of State in Africa must create a conducive atmosphere for AI to flourish. Rigid regulatory regimes can stifle any ecosystem's growth,

especially when it wants to scale across national borders. Africa's business leaders may help shape AI policy by collaborating with federal governments. African businesses can address data privacy issues by

establishing standards for gathering, distributing, and

storing data. Researchers, companies (including startups and entrepreneurs), and civic society (including NGOs and think tanks), legislators, and regulators should collaborate and increase information exchange and cooperation. A collaborative method like this encourages sharing AI knowledge and perspectives, enabling a proper understanding of technology within the region. This strategy assures that legislative and regulatory actions protect citizens while also promoting the advancement of technology [20].

#### 5.4 Proper Data Management System

According to [92], a workflow integration coupled with data governance, analytics technology, ambidextrous corporate culture ensures an effective AI transformation. Therefore, businesses, policymakers, and entrepreneurs in Africa must place an efficient and effective data management system to protect customers' privacy. A report by [93] suggested that African countries like Kenya, Ghana, South Africa, Uganda, and Tunisia enhanced their data protection and ethical strategies. The study stressed the significance of solid data protection, regulation, and ethics-by-design in all AI processes. Comprehensive data is essential for driving innovation, attracting talent, and training artificial intelligence systems. Also, the study observed that, implementing data standards and making data available to both local and foreign stakeholders will improve the data repository system in Africa.

#### 5.5 Investment

Investors may also help to ensure that the AI revolution benefits ordinary Africans. Investors must promote both the long-term human and financial progress of AI development. They can do so by investing in firms like Zipline that employ AI for social and developmental good or by working with civil society organizations [90]. Corporate investment in AI should be encouraged to help in achieving industrialization in Africa. For instance, recently, an IBM laboratory research was established in Nairobi to advance technological developments in Kenya. In Ghana, Microsoft 2020 and Google 2019 launched AI laboratories to drive progress through meaningful innovation and action.

#### 5.6 Benchmarks from around the world

AI development is a global competition in which many countries strive to be ahead. According to [20], support for the AI ecosystem is growing as governments worldwide become more aware of the potential economic and social benefits of creating and

implementing AI. Many governments have taken an active role in fostering AI research in their countries, as depicted in Table 4.

Table 4 Some International Benchmark Strategies of AI

Country	AI Strategy	Details	Citation
Canada	Pan-Canada AI Strategy	Enhance international profile and visibility in AI research and training.	[93]
China	China Next Generation Artificial Intelligence Development Plan	China plans to establish a domestic AI sector worth approximately \$150 billion in the next few years to become the world's leading AI power by 2030.	[94], [95]
India	National Strategy for Artificial Intelligence	It also looks at how India might use transformational technology to promote social and inclusive growth in keeping with the government's development philosophy.	[96]
United Kingdom	Artificial Intelligence Sector Deal	The government and the AI sector have agreed on a Sector Deal to boost the UK's global position as a leader in developing AI technologies.	[97]
United Arab Emirates	Artificial Intelligence Strategy	The UAE Centennial 2071 aims to improve government performance at all levels by implementing an integrated intelligent digital system capable of overcoming difficulties and providing rapid and effective remedies.	[98]

## 6.0 Conclusion and Policy Recommendations

AI is on the verge of becoming central in the debate for transformational agenda, as seen in countries like the United States of America, China, and significant parts of Europe. The study investigated the ways of improving Africa's technological metamorphosis through AI. The research used content analysis and case study analysis, and the findings indicate that AI has a strong effect on the attainment of transformational agenda on the Africa continent. The study discovered that Africa had made some progress within AI, with countries like South Africa, Nigeria, Kenya, and Ghana being the leading giants in AI. [20] found out that multinational corporations, particularly technology companies, are investing in establishing AI research and innovation centers in emerging markets like Ghana, Kenya, South Africa, Nigeria, etc. According to a study by [99] Mary Carman, 2020, while ML and AI research and development in Africa have a long history, it has traditionally taken place in limited places.

The study discussed a case study of the top five leading companies in AI. The analysis revealed that



top firms such as Kudi in Nigeria Lagos created a platform through AI where customers can make money transactions, bill payments, and cash withdrawals through AI chatbot. Also, Aerobotics in South Africa, with the use of drones and robotics, assists farmers in tracking and accessing crops' health. In Kenya, Apollo Agriculture, through remote sensing and ML, helps farmers access credit and high-quality farm inputs. Tunisia-based Datavora employs an automated monitoring system for e-commerce B2C retail to add value to their customers' decision-making processes. UTU Technologies in Kenya, through their "trust infrastructure," provides a recommendation platform based on social media connection where customers who have trust issues can engage and transact safely.

The study identified some challenges for implementing AI from a global perspective, including ethical, social, economic, political, data quality, managerial and organizational, and technical, and provides some studies investigating this study area. In Africa, challenges such as ethics, data quality, unreliable power supply, human capital, education and skills, lack of investment, unreliable and affordable internet connectivity were identified as barriers to AI. Therefore, to overcome these challenges and pave the way for the transformational agenda that the Africa continent seeks, the study provides some strategies that heads of States in Africa, policymakers, and all stakeholders can adopt for AI to thrive on the continent.

Africa countries can harness the potential of AI to reduce poverty, health issues, transportation, agriculture, disability, food security, and other perennial problems confronting the continent. This can be achieved when proper investment is made in AI, and the necessary environment is created for the survival of AI in Africa.

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