



Access  
Partnership

Artificial Intelligence for  
Africa: An Opportunity  
for Growth,  
Development, and  
Democratisation

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## EXECUTIVE SUMMARY

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The rapidly developing set of artificial intelligence (AI) technologies has the potential to solve some of the most pressing challenges that impact Sub-Saharan Africa and drive growth and development in core sectors:

- Agriculture will be done more efficiently and effectively, raising yields.
- Healthcare will be bettered tailored, higher quality, and more accessible, improving outcomes.
- Public services will be more efficient and more responsive to citizens, enhancing impact.
- Financial services will be more secure and reach more citizens who need them, expanding access.

Forward thinking policy-makers, innovative startups, global technology partners, civil society groups, and international global stakeholders are already mobilising to promote the growth of a vibrant AI ecosystem in Africa. However, there remain structural challenges that can hamper the development of a healthy AI ecosystem in Africa:

- Education systems will need to adapt quickly, and new frameworks need to be created for workers and citizens to develop the skills they need to thrive.
- Broadband coverage will need to expand rapidly — specifically in rural areas — in order for all citizens and businesses to reap the benefits.
- Ethical implications regarding the fair, secure, and inclusive use of AI applications also must be addressed through collaboration and engagement to ensure AI systems earn trust.
- Ensuring a deeper, broader, and more accessible pool of data is available will also be key to enable researchers, developers, and users to drive AI.

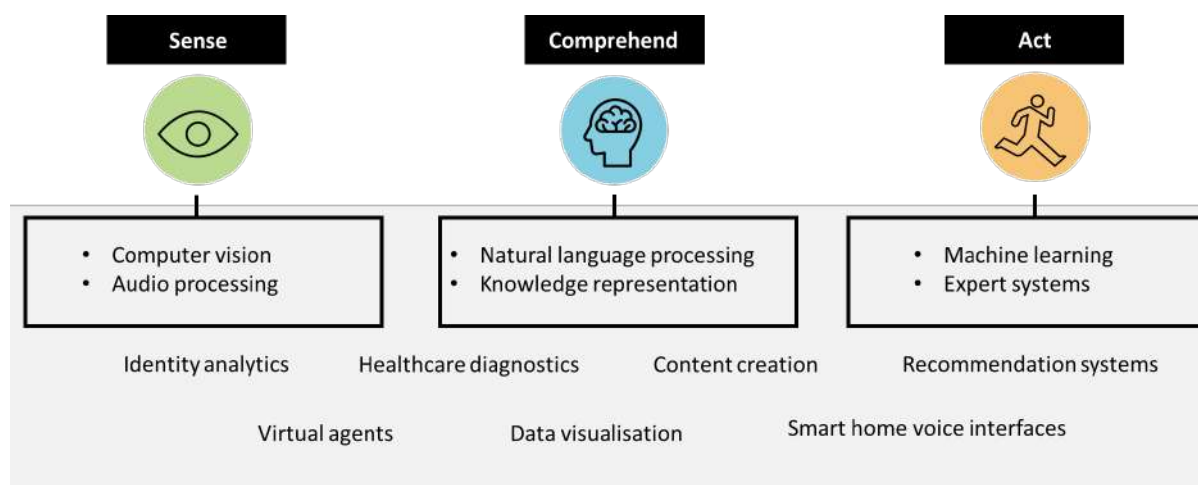
As with other transformative and revolutionary technologies, there are challenges inherent in the development of AI. Governments can embrace these challenges and benefit from AI by creating clear roadmaps to guide the adoption of this technology. They should recalibrate their laws and legal frameworks to support data-driven technologies and innovation-driven growth; strengthen the supporting infrastructure for development; and set the tone of a collaborative approach that allows all stakeholders to share their expertise, insights, and build trust. With the right mix of policies, Africa and its citizens can reap the benefits of the transformations in the years to come.<sup>1</sup>

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<sup>1</sup> We thank Prof. Nelishia Pillay, Head of the Computer Science Department of the University of Pretoria, South Africa. For her valuable contribution to this paper.

## WHAT IS AI?

AI is a constellation of technologies that enable machines to act with higher levels of intelligence and emulate human capabilities to sense, comprehend, and act. These human capabilities are augmented by the ability to learn from experience and adapt over time. In other words, AI enables machines to sense their environment, think, and in some cases learn, to take action in response to the environment and the circumstances underpinning it. AI systems are finding ever-wider application across enterprises as they grow in sophistication.



AI is still maturing as a technology. Today's AI systems still have a relatively rudimentary ability to understand human expression, tone, emotion, and the subtleties of human interaction.<sup>2</sup> Most of the progress to date has been in teaching computers to perform narrow tasks — to play a game, to recognise an image, or to predict traffic, for example. There is still a long way to go before computers can really act as humans.<sup>3</sup> While AI development has a long history of excitement followed by long disappointment, today we are experiencing an unprecedented period of technological innovation across various sectors that is driving the growth of AI. The two critical factors driving this growth are the increase of digitised data in the global economy and the unlimited access to computing power, and lower costs for data storage now available over the cloud.<sup>4</sup>

The data explosion is at the heart of AI. Massive amounts of data from increasingly pervasive sensors, social networks, and mobile devices are unlocking new opportunities. By 2025, global data traffic will grow to 163 zettabytes (that is a trillion gigabytes). This exponential growth is constantly feeding AI improvements: "Data is to AI what food is to humans."<sup>5</sup> AI developers rely on this data to train and

<sup>2</sup> Microsoft, The Future Computed, p. 34

<sup>3</sup> What is referred to as general AI, a type of intelligence that can be used to complete a wide range of tasks in a wide range of environments (and as such is much closer to human intelligence). What we do have today is narrow AI, a type of intelligence that is limited to a single task or a set number of tasks. Narrow AI exhibits some facet(s) of human intelligence, and can do that facet extremely well, but is lacking in other areas. Microsoft, The Future Computed, p. 34

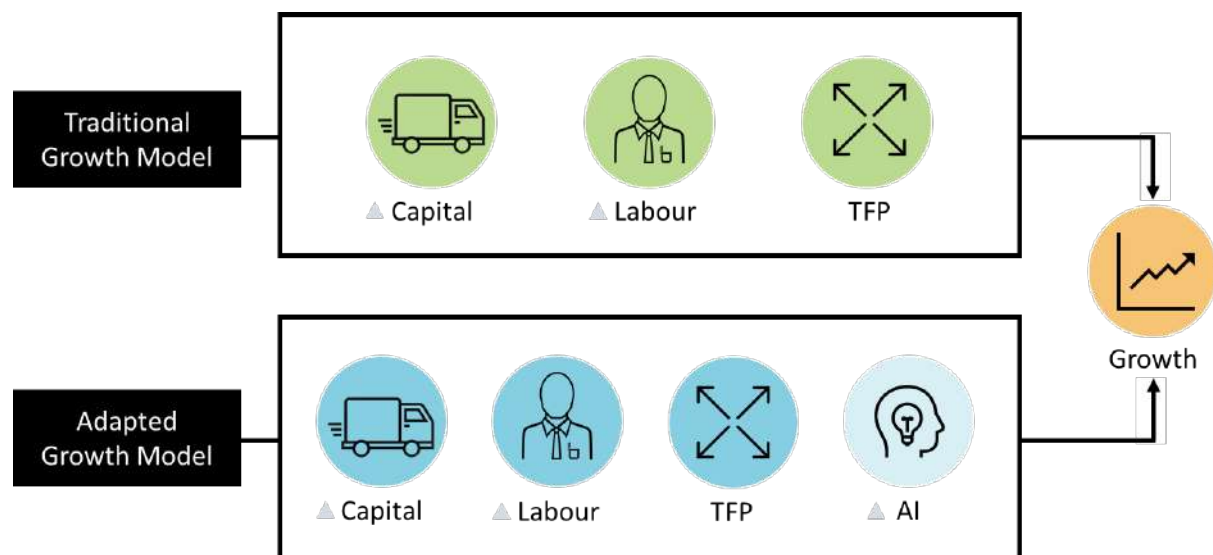
<sup>4</sup> Over the past three decades, the hard drive cost per gigabyte of data has been falling exponentially, to the extent that we are approaching near zero marginal cost for storing data (down from USD 500,000 a gigabyte in 1980 to 2 cents a gigabyte in 2017). For more information on the historical cost of computer memory and storage, see the [hblok website](#).

<sup>5</sup> Data Age 2025: The Evolution of Data to Life-Critical whitepaper by International Data Corporation, 2017 in India's National Strategy for Artificial Intelligence #AIFORALL, Discussion Paper, June 2018, p. 14

refine their systems. Only with data can computers learn how to identify the patterns, often subtle, that enable them to “see,” “hear,” and “understand.”

This massive amount of data requires extensive computing power in order to be stored and processed. Cloud computing responds to these demands and creates valuable data for AI. Massive computing power can be applied to statistical algorithms, allowing them to learn from patterns over time. Cloud enables people and businesses to access this computing power on demand, arming them with the tools to research, educate, and develop AI applications. Since it is available anywhere with an Internet connection, cloud democratizes access to these tools for businesses of all sizes, allowing them to scale their purchases to their needs.

Driven by these two factors, AI will be the largest technology revolution of our times and has the potential to disrupt almost all aspects of human existence. Like the great technological breakthroughs over the last century — electricity, railways, and information technology — AI will boost productivity dramatically, maximising output and growth. More radically than these previous revolutions, AI will create an entirely new factor of production.



NB: ▲ indicates the change in that factor.  
TFP: Total Factor Productivity

Source: Accenture, *Why Artificial Intelligence is the Future of Growth*

As a new factor of production, AI can drive growth in at least three important ways:

- **Intelligent automation of the workforce.** Intelligent automation means the ability to automate complex tasks in the physical world that previously required human abilities to navigate obstacles and solve problems. For example, warehouse retrieval has transformed from a

labour-intensive task to an advanced automated system thanks to intelligent robots that feature advanced sensing capabilities. Whereas traditional automation technology is task specific, AI-powered intelligent automation is able to solve problems across industries. Further, intelligent automation allows for self-learning machines/software recognise gaps in their own knowledge and take steps to close them. Whereas traditional automation capital degrades over time, intelligent automation assets constantly improve.

### Automation and AI

The terms “automation” and “AI” are often used interchangeably. However, while these applications complement one another, they are different:

- Automation allows systems to be programmed to perform specific repetitive tasks.
- AI is designed to seek patterns, learn from experiences, and make appropriate decisions — it does not require an explicit programmed path to determine how it will respond to the situations it encounters.
- Automated machines collate data — AI systems ‘understand’ it.
- AI complements and accelerates automation.

- **Augment both labour and physical capital.** AI can provide enormous value not just in substituting for human labour, but in complementing both labour and physical capital in ways that enhance productivity. By automating repetitive tasks, employees can instead focus on high value-add and more advanced cognitive functions of their jobs. For example, instead of spending time compiling data and crunching numbers, administrators, accountants, and loan officers can instead focus on communication, relationships, and better assessing risk by leveraging higher quality data. AI also enhance the value of existing capital goods by enabling businesses to design ways to use them more efficiently, for example by reducing downtime in manufacturing.
- **Drive innovation.** By allowing creators and innovators to focus on where they add value, AI frees them to solve complex problems and scale their creative efforts. This results in new, more innovative products that diffuse throughout the economy, enhance growth, and improve outcomes for consumers.

AI will have a significant impact by enabling faster and more profound progress in almost any field where (human) intelligence has a role to play. Businesses or organisations can use it to engage with customers, transform product development, optimise operations, and empower employees. But even more importantly, AI can help society overcome some of its most daunting challenges.

### AI Solutions for Social and Economic Development

**AI and Disabilities** — Apple is teaming up with leading educators for blind and deaf communities across the US to bring accessible coding to their schools. Beginning fall 2018, schools supporting students with vision, hearing or other assistive needs will start teaching the “Everyone Can Code” curricula for Swift, Apple’s intuitive programming language. The schools will tailor lessons using Apple’s accessibility technology. Apple collaborated with engineers, educators, and programmers from various accessibility communities to make Everyone Can Code as accessible as possible and will continue to work in close coordination with schools to augment the curricula as needed.

**AI and Oil and Gas** — Hitachi is working to develop and IoT solution to enable more effective and sustainable drilling and transmission operations. The solution allows operators and service providers to remotely



monitor and manage natural gas compressor skids to detect compressor shutdowns, maintain operational efficiencies, predict failures and provide multi-compressor analysis. Designed to monitor, analyse, and report on key performance indicators (KPIs) based on compressor runtimes, performance, reliability and costs, the Hitachi IoT solution integrates the entire natural gas production service provider ecosystem. Equally important, it helps companies optimise asset utilisation, getting the most from their investment.







**AI and Education** — Microsoft, in collaboration with the district of Tacoma, WA, developed a solution that captures recent data from the district's student information system, containing student grades, attendance, health records and other data. These comprehensive data snapshots allow teachers and principals to predict dropout probability and enable them to provide additional learning assistance early enough to turn at-risk students around. Thanks to this solution, the district has already helped to improve graduation rates from 55 to 78 percent.

**AI and the Automotive Industry** — NVIDIA has developed DRIVE, an AI platform that enables automakers, truck makers, tier 1 suppliers, and startups to accelerate production of automated and autonomous vehicles. The platform combines deep learning, sensor fusion, and surround vision to change the driving experience. It is capable of understanding in real-time what is happening around the vehicle, precisely locating itself on an HD map, and planning a safe path forward.



## WHAT WILL AI MEAN FOR AFRICA?

In Africa, AI can help with some of the region’s most pervasive problems: from reducing poverty and improving education, to delivering healthcare and eradicating diseases, addressing sustainability challenges — from meeting the growing demand for food in the fast-growing population to advancing inclusion in societies.<sup>6</sup> AI democratises access to innovative and productivity-boosting technology to fuel the growth the continent needs.

					
Health	Transportation	Education	Public services	Food production	Disabilities
AI offers vast opportunities to transform how we understand disease and improve health.	AI can provide safe and efficient transportation; expand the capacity of existing road infrastructure and improve traffic flow. It can also reduce carbon emissions and facilitate greater inclusiveness.	AI can develop predictive models for engagement and comprehension. It can be used to develop new approaches to education that may revolutionise how people learn.	AI can improve how governments interact with their citizens and deliver services. It can create efficiencies, reduce burdens, and eliminate redundancies.	AI offers significant opportunities to increase food production by improving agricultural yield and reducing waste.	AI can help address some of the problems faced by the more than 80 million people in Africa.

In addition, AI is fundamentally reshaping how work is done, allowing for a more efficient allocation of resources leading to increased productivity and, in the case of government, improving the delivery of services to citizens. AI will also generate new, high-value jobs requiring technical skills, such as network engineers in the banking sector or web programmers in the retail industry. Demand for data scientists, robotics experts, and AI engineers will increase significantly. Further, AI unlocks the value of data, enhances cognitive processes, and improves predictive capabilities. This would allow governments in the region to drive better policy and decision making.<sup>7</sup>

### Growth in Key Sectors

AI is set to fuel new economic growth. According to a recent study on the long-term economic impact of AI around the world, AI has the potential to double a country’s GDP growth rate by 2035.<sup>8</sup> The ability to harness even a fraction of this benefit would be a powerful tool for development and poverty reduction. This impact will be particularly strong in a few core sectors that are key for Africa, including agriculture, healthcare, public services, and financial services.

<sup>6</sup> Microsoft, *The Future Computed*, p. 13

<sup>7</sup> Hila Mehr, [Artificial Intelligence for Citizen Services and Government](#), Harvard Kennedy School, ASH Centre for Democratic Governance and Innovation, 2017

<sup>8</sup> Accenture report, [“Why Artificial Intelligence is the Future of Growth”](#). Between them, the 12 countries generate more than half of the world’s economic output. Accenture and Frontier Economics modelled each country’s economy in 2035 in a baseline scenario that shows expected economic growth under current assumptions. They then compared this with a growth scenario that allows for AI being absorbed into the economy over the next 18 years. AI would appear to yield the biggest economic benefits for the world’s largest economy, the US. The modelling suggests that its annual growth rate would leap from 2.6pc today to 4.6pc in 2035, generating an additional USD 8.3trn for the economy. The UK could boost its annual growth from 2.5pc to 3.9pc, generating an extra USD 814bn.

## **Agriculture**

Agriculture is critical to Sub-Saharan Africa's growth; the sector employs over 65 percent of the continent's labour force, and accounts for 32 percent of gross domestic product (GDP). The World Bank estimates that African food markets will be worth USD 1 trillion by 2030 up from the current USD 300 billion. Demand for food is projected to at least double by 2050, driven by population growth, rising incomes, rapid urbanisation, changes in national diets, and more open intra-regional trade policies, all of which are helping create new opportunities for Africa's farmers. It is estimated that a 1 percent increase in crop productivity reduces the number of poor people by 0.72 percent in Africa.<sup>9</sup>

However, the sector is burdened with important limitations:

- degradation of land;
- reduction in soil fertility;
- increased dependence on inorganic fertilisers;
- dropping water tables;
- emerging pest resistance; and
- increased vulnerability and unpredictability of global climate

Its weak supply chain, low productivity, and vulnerability to climate heighten the risks of food scarcity and agricultural distress. Moreover, technology adoption has been slow and resource usage is inefficient. The sector would welcome and benefit from innovation.

AI, along with machine learning, satellite imagery, and advanced analytics has the potential to improve productivity and efficiency at all of the stages of the agricultural value chain. These technologies can empower small-holder farmers to increase their income through higher crop yield and greater price control. For example, drone technology can be used to plant and fertilise seeds at a speed beyond human abilities. AI-powered analytics of crop data can also help identify diseases, enable soil health monitoring without the need of laboratory testing infrastructure,<sup>10</sup> and facilitate the creation of virtual cooperatives to aggregate crop yields and broker better prices with suppliers.

## **AI Solutions for Agriculture**

**FarmDrive** — The Kenyan data analysis startup is an alternative credit scoring platform for smallholder farmers. It uses mobile phones, alternative data, and machine learning to close the critical data gap that prevents financial institutions from lending to creditworthy smallholder farmers.<sup>11</sup>

**Sowing App** — Microsoft and ICRISAT developed the Sowing App to help farmers achieve optimal harvests by advising on the best time to sow depending on weather conditions, soil and other indicators, leading to higher yields. The Sowing App utilised powerful AI to interface with weather

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<sup>9</sup> Colin Thirtle, Lin Lin and Jenifer Piesse, "The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America," *World Development* (Vol 31 Issue 12), 2003.

<sup>10</sup> Africa Agriculture Status Report 2017, The Business of Smallholder Agriculture in Sub-Saharan Africa, Alliance for a Green Revolution in Africa (AGRA)

<sup>11</sup> For more information on FarmDrive, see [company website](#).

forecasting models and extensive data that was downscaled to build predictability and guide farmers to pick the ideal sowing week.<sup>12</sup>

**See & Spray** — Blue River Technology has built “smart farm” machines to manage crops at a plant-level. Today, the best practice is to treat all plants as if they have the same needs. However, their See & Spray technology changes this paradigm, empowering growers to make every individual plant count at scale. Using computer vision and AI, their smart machines can detect, identify, and make management decisions about every single plant in the field.<sup>13</sup>

## **Healthcare**

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

AI can help plug these gaps and enhance outcomes, and large corporations and startups alike are developing AI-focused healthcare solutions for these challenges. There are rich use cases for AI in the healthcare field:

- **Empower and supplement staff** — AI solutions can help scarce personnel and facilities do more with less by speeding initial processing, triage, diagnoses, and post-care follow up, thereby stretching their limited time to serve more patients and increasing accessibility.
- **Improve public health policy** — AI technology can be used to better understand patterns in the spread of disease, as well as design more effective public health measures in response.
- **Improve healthcare delivery** — AI-based healthcare solutions can help to make healthcare services more proactive. Instead of “sick” care that reacts to serious problems, advanced data analytics can help practitioners identify potential problems early and tailor better preventive care in response. Earlier interventions — before a health problem becomes a health crisis — mean that health-care delivery can be cheaper, easier for the patient, and result in better health outcomes.
- **Better diagnostics and detection** — By analysing patterns in health and testing data, such as machine vision analysis of x-rays, AI can be a critical assistance that makes faster and more accurate diagnoses. It enables health workers to interpret findings to identify specific problems and interventions amid complex scenarios with different variables interacting at one time.
- **Improve access** — AI tools, such as online conversation agents and machine vision, can extend access to millions of people and remotely diagnose various health conditions using images from the cameras of everyday smartphones.

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<sup>12</sup> For more information on the Sowing App, see [Microsoft website](#).

<sup>13</sup> For more information on Blue River Technology, see [company website](#).

- **Tailor medical intervention** — AI based pharmacogenomic applications, which focus on the likely response of an individual to therapeutic drugs based on certain genetic markers, can be used to tailor treatments to the patient. Considering that Africa is the most genetically diverse continent, advancement in this area may have profound ramifications.

## AI Solutions for Healthcare

**Sophie Bot** — Developed by a Kenyan startup, this free chatbots provides a platform for questions on sexual and reproductive health. In a society where talking about sexual health is often a taboo, Sophie Bot provides anonymity, credible answers, platform independence and a user-friendly conversational interface. This service is available on several popular messaging apps, including Messenger and Twitter.<sup>14</sup>

**Seeing AI** — Microsoft’s project is designed to help the blind and low vision community by harnessing the power of AI to turn the visual world into an audible experience. The Seeing AI intelligent camera app allows users to hear information about the world around them just by holding up their phones as it can describe people, text, currency, colour, and objects. It can speak short text as soon as it appears in front of the camera, provide audio guidance to capture a printed page, and recognize and narrate the text along with its original formatting. The app can also scan barcodes with guided audio cues to identify products, recognize and describe people and their facial expressions, as well as describing scenes using the power of AI. Seeing AI is an ongoing project that keeps developing new abilities.<sup>15</sup>

**Corti** — A Danish machine learning company providing accurate diagnostic support to emergency services, allowing patients to get the right treatment faster. It helps emergency medical dispatchers make life-saving decisions by identifying patterns of anomalies or conditions of interest with a high level of speed and accuracy. In the case of out-of-hospital cardiac arrest (OHCA), the technology can reduce the number of undetected OHCA by more than 50 percent.<sup>16</sup>

## Government (Public Services)

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In many African countries, citizens’ experience with public services can often be challenging. Delivery is characterised by backlogs; redundant tasks; lack of accuracy; slow response times; and generally poor quality, which leads to low levels of citizen satisfaction. Governments’ ability to ensure efficient use of resources in the delivery of public services is impaired due to factors such as corruption and lack of transparency, as well as public service delivery modes that struggle to respond to present day needs. Thus, while delivery of public services commonly accounts for a large proportion of government budgets, increased spending is often not matched by improvements in outcomes.

Through automation, AI technologies can significantly streamline processes and reduce costs: it can ease administrative burdens, paperwork, and backlogs, increasing public sector efficiency and the speed at which public services can be delivered. This will allow public sector managers to resolve resource allocation constraints, redirecting the staff where they can be most productive.<sup>17</sup>

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<sup>14</sup> For more information on Sophie Bot, see [company website](#).

<sup>15</sup> <https://www.microsoft.com/en-us/garage/wall-of-fame/seeing-ai/>

<sup>16</sup> For more information on Corti, see [company website](#).

<sup>17</sup> If used effectively, AI can lead to important savings in public money. For example, in the UK, just the use of AI virtual agents across Government departments and the public sector is expected to save an estimated £4 billion a year. For more information, see [techUK – Written evidence \(AIC0203\)](#)

In addition to making the delivery of existing services more efficient, AI will drive innovation, enabling new and better types of public services. AI’s predictive capabilities are a game-changer for how government services and policies can respond to society’s needs: from pre-emptive social service interventions to help children and struggling students to better crime reporting and emergency response. AI tools can also better administer infrastructure, anticipating the need for repairs and better managing cyberattacks that threaten critical systems.<sup>18</sup>

Finally, AI tools will enhance citizen participation. They can provide new platforms for citizens to assess the quality, adequacy, and effectiveness of public services as well as express their needs and preferences. This provides government with more information to improve their services and make more informed policy decisions.<sup>19</sup>

African governments could help demonstrate AI’s potential benefits and foster public trust in the

Answering questions	Filing out and searching documents	Routing requests and classifying petitions	Translation	Drafting documents
Use of chatbots to solve basic administrative issues. In the future, AI could also be used for sentiment analysis of requests and conversations to better understand citizen inquiries and feedback.	Bots can help auto-populate forms and provide applicants with instructions for next steps. AI can quickly categorise and search a range of documents and images, as well as scan advanced legal documents.	Algorithms can be used to classify citizen petitions and route them to the correct office, as well as solve customer inquiries more quickly, saving time and resources.	Combined with human editors to verify for accuracy, AI can complete translations in a much more cost-efficient way than traditional translation services.	Natural Language Generation (NLG) AI can be used to draft documents. NLG can also help non-data science employees better and more efficiently understand the data.

technology.<sup>20</sup> Governments can also help the development of the local AI industry by seeking solutions that use AI to address various governmental needs and thereby creating demand of this technology.

## AI Solutions for Government

**Spatial Wave** — The Microsoft CityNext Partner designed SANSTAR for the Los Angeles Bureau of Sanitation (LASAN) using Microsoft Azure cloud services. The smartphone application is used by truck drivers to map and record their daily routes and by citizens to report clean-up issues. The mobile app allows drivers to complete their routes faster and respond to more customer requests.<sup>21</sup>

**Veritone**— This platform enables federal, state and local government agencies to seamlessly and automatically process, transform and analyse their data. The discovery of mission-critical information is

<sup>18</sup> Hila Mehr, [Artificial Intelligence for Citizen Services and Government](#), Harvard Kennedy School, ASH Centre for Democratic Governance and Innovation, 2017

<sup>19</sup> Dina Ringlod, *Citizens and Service Delivery: Assessing the Use of Social Accountability Approaches in Human Development Sectors*, December 2011, The World Bank.

<sup>20</sup> The report also notes that the big challenge for these countries – and globally -, is scarcity of AI developer talent. Governments need to re-think education for a future workplace redefined by AI and start building a healthy, collaborative, and open AI ecosystem to attract and retain competitive AI talent. According to a [report](#) by IDC, spending on cognitive and AI systems in the Middle East and Africa (MEA) region will reach USD 114.22 million by 2021, with the market expected to represent a compound annual growth rate of 32 percent for the 2017-2021 period

<sup>21</sup> For more information on SANSTAR, see [Microsoft website](#).

expedited across content silos by cognitively processing and searching for faces, objects, spoken words, logos and more.<sup>22</sup>

## **Financial Services Industry**

Financial sector development has been identified as a key factor in reducing poverty in developing economies. In Africa, the objective is to ensure that the next 100 million Africans can be financially included within the next decade.<sup>23</sup> AI has the potential to achieve this by changing the way Africans access financial services, save money, invest, and get insured.

African banking markets have been described as some of the most exciting in the world: they are fast-growing, nearly twice as profitable as the global average, and a hotbed of innovation.<sup>24</sup> Leading actors in the sector have been proactive and innovative in developing new business models in response to the specific challenges of the region including low levels of banking penetration, heavy use of cash, sparse credit bureau coverage, and limited branch and ATM networks. A growing number of tech savvy African customers demand very sophisticated banking service.<sup>25</sup> Recent studies suggest that approximately 40 percent of African banking customers prefer to use digital channels for transactions over branch channels.<sup>26</sup> Further, in the continent's major banking markets — including South Africa and Nigeria — this share is significantly higher. For example, in Nigeria, 59 percent of customers prefer digital, compared to 15 percent that favour branches.<sup>27</sup>

Digitisation and innovation are two key factors in financial services providers' ability to grow and distinguish the leading from the lagging financial service providers in the region.<sup>28</sup> Financial institutions must continue to innovate and embrace cutting-edge technology such as AI and leverage analytics and data to create efficiencies, reduce costs, and improve customer experience. This technology will also enable them to automate their processes seamlessly to achieve improvements in frontline productivity and open new streams of revenue to remain competitive.<sup>29</sup> Equally, it can help improve financial institutions' risk management, credit allocation, and fraud detection capabilities, as well as increase their share of digital sales and transactions. Likewise, they should partner with FinTech startups and SMEs developing AI solutions for financial services (rather than seeing them as threats to their business).

Some of the most evident areas where AI can help financial service providers in terms of automation, cost reduction and increase of efficiency, are:

- **Anti-Money Laundering (AML)** — AML alert investigation, case management and decision making.

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<sup>22</sup> For more information on Veritone, see [company website](#).

<sup>23</sup> Africa's retail banking penetration stands at just 38 percent of GDP, half the global average for emerging markets. European Investment Bank, Recent Trends in Banking in sub-Saharan Africa, From Financing to Investment, July 2015.

<sup>24</sup> For more information on African banking markets, see [Business Daily website](#).

<sup>25</sup> For more information on African banking infrastructure, see [Ameyo website](#).

<sup>26</sup> Deloitte Centre for Financial Services, 2018 Banking Outlook: Accelerating the Transformation (2018)

<sup>27</sup> For more information on Egypt's banking sector, see report on [Albawaba website](#).

<sup>28</sup> Other factors include geographic footprint; identifying the right target segments of population; and the ability to create leaner banking models.

<sup>29</sup> The report surveyed 600 bankers, 80 percent of whom felt that AI was set to become the main channel of communication between banks and customers. For more information on Nigeria's banking sector, see [ITPulse website](#).

- **Monitoring and change management** — Regulatory change management can capture new obligations, analyse, and assess its impact on the organisation; identify the new requirements that need to be implemented; create action plans; and monitor effectiveness of implemented changes.
- **Customer and client satisfaction** — Machine learning can help financial services firms track customer behaviour to offer tailored financial advice.
- **Reacting to market trends** — Smart machines can be trained to track trading volatility or manage wealth and assets on behalf of an investor. These algorithms can identify trends more efficiently than humans and react in real-time.
- **Calculating risk** — Smart machines can analyse a large number of disparate datasets (such as credit scores, spending patterns, financial data) to accurately assess risk in both insurance underwriting and loan assessments, tailoring them to a specific customer profile.

## AI Solutions for Financial Services

**Zenith Bank Plc** — Located in Nigeria, Zenith launched several new solutions that enable more convenient, safe and quick customer transactions. These include the bank’s Scan to Pay App which can be used by Zenith and non-zenith customers to make online and in-store payments in seconds through quick response code scanning on any internet enabled phone. The bank’s mobile app also offers enhanced functionalities such as instant account opening for new customer.<sup>30</sup>

**ALAT** — Africa’s first fully digital bank, launched in May 2017 by Wema Bank in Nigeria. ALAT targets the youth segment based on the three pillars of convenience, simplicity, and reliability. Customers can open an account via mobile phone or Internet in under five minutes and debit cards are delivered anywhere in Nigeria within two to three days, free of charge. ALAT also promises “no paperwork”: photos of KYC documents can be uploaded via mobile app or website.<sup>31</sup>

**Strider** — A South African fintech company that provides a toolbox of platforms that banks and financial institutions can rapidly white-label in order to provide financial education and meaningful services to new and existing clients.<sup>32</sup>

## Education

Education is one of the areas where AI is poised to have greater impact. This technology can be used to automate basic activities, like grading, freeing up time for teachers to perform other important tasks, including interacting with students, preparing for class, or working on professional development. Likewise, it can offer additional support to students through intelligent tutoring systems and automated teaching agents. Learning difficulties are experienced in different facets of education. Individualized tutors are usually needed to assist learners overcome these difficulties. However, due to budget constraints the provision of individualized tuition is not an option in some instances. This is a common challenge facing primary, secondary and tertiary education institutions in Africa.

Intelligent tutoring systems can be effective in providing individualized tuition by tailoring educational material to students’ needs and generally helping them work at their own pace. Furthermore, they

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<sup>30</sup> For more information on the Scan to Pay App, see [company website](#).

<sup>31</sup> For more information on ALAT, see [company website](#).

<sup>32</sup> For more information on Stock Shop, see [company website](#).



can be used to re-skill workers (and to do so faster than through face-to-face instruction), which will become an increasingly important task for public and private sector employers alike.

AI can also be used to monitor student progress and alert teachers when there might be an issue with performance, providing useful feedback on the effectiveness of courses. Moreover, it can be employed to predict dropouts and allow academic institutions to take adequate preventive measures. Dropout rates across the continent are high; this has significant consequences in terms of social and economic development, the loss of opportunity to develop African talent, and the cost to academic institutions<sup>33</sup>.

African governments should seek to establish working groups focused on applications of AI for education to support the development and implementation of AI tools and techniques in this important sector. Likewise, this would make it possible to achieve certain degree of standardization and avoid waste of resource by preventing duplication of efforts.

### AI Solutions for Education

**Georgia Tech University (GTU)** – GTU developed “Jill Watson”<sup>34</sup>, an AI teaching assistant based on IBM's Watson platform<sup>35</sup>. The system was developed specifically to handle the high number of forum posts by students enrolled in an online course that is a requirement for GTU's online master of science in computer science program. It attained a 97% accuracy rate in answering student queries – and according to reports by GTU, most students were unaware that “Jill Watson” was not a real person.

**China** - China is developing AI technology to understand the general logic and meaning of text in academic essays and make a reasonable, human-like judgment about their overall quality. It then grades the work, adding recommended improvements in areas such as writing style, structure and theme. The technology, which is being used in around 60,000 schools, is supposed to “think” more deeply and do more than a standard spellchecker. The technology is designed to assist - rather than replace - human teachers as it could help to reduce the amount of time they spend on grading essays and help them avoid inconsistencies caused by human errors such as lapses in attention or unconscious bias<sup>36</sup>.

**ETS**<sup>37</sup> – The team of education experts uses e-rater to identify features related to writing proficiency in student essays so they can be used for scoring and feedback. The e-rater engine provides a holistic score for an essay as well as real-time diagnostic feedback about grammar, usage, mechanics, style and organization, and development. This feedback is based on natural language processing research specifically tailored to the analysis of student responses. Teachers use the tool to help their students to develop their writing skills independently and receive automated, constructive feedback. Equally, students use its engine's feedback to evaluate their essay-writing skills as well as to identify areas that need improvement.

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<sup>33</sup> <https://wenr.wes.org/2017/05/education-south-africa>

<sup>34</sup> <https://pe.gatech.edu/blog/meet-jill-watson-georgia-techs-first-ai-teaching-assistant>

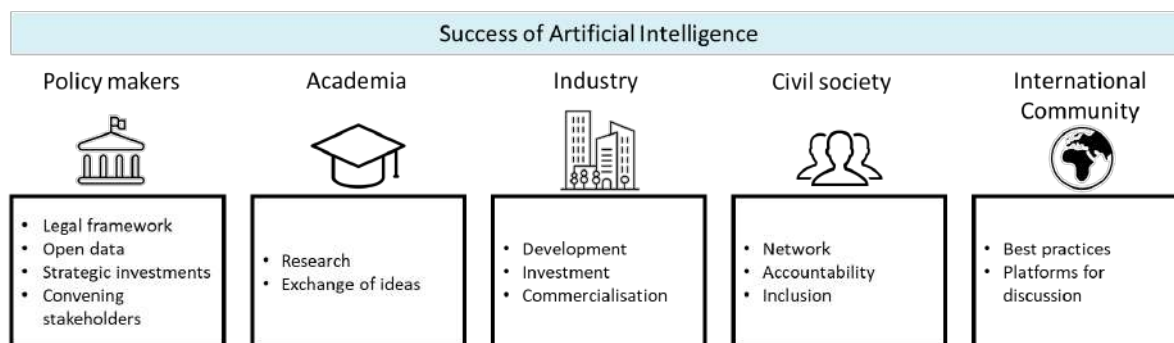
<sup>35</sup> <https://www.ibm.com/watson/>

<sup>36</sup> <https://www.scmp.com/news/china/society/article/2147833/chinas-schools-are-quietly-using-ai-mark-students-essays-do>

<sup>37</sup> <https://www.ets.org/about/who/>

## WHO ARE AFRICA'S AI STAKEHOLDERS?

There are many players involved in the creation of a vibrant AI ecosystem. From setting policy and regulatory frameworks to sharing best practices, from generating data to developing and commercialising applications, all have a crucial role to play.



### Policy-Makers

Policy-makers are at the centre of the development of AI. As the technology expands into countries' economies and societies, governments are increasingly active, both as policymakers and users of the technology. While many stakeholders play different roles, government is uniquely capable of taking a broad view of AI and its impacts, promoting the conditions for its growth, and addressing the challenges and questions that arise from its use.

Policy-makers determine the legal, regulatory, and business environment that rewards innovation, investment, and technology-based development. Forward thinking governments around the world are already working to enable AI and the digital economy more broadly through steps such as framing clear and innovation-friendly data protection frameworks, implementing cybersecurity policies, promoting cloud uptake, and promoting high quality connectivity for all.

Governments run national education systems, research institutes, and many skilling initiatives that equip workers to participate in the AI economy and can contribute to AI advancements. They also are the stewards of vast amounts of data that can provide the raw material for researchers and innovators to develop applications and have the power to make it available and useful.

Finally, governments are a critical platform for dialogue and bringing together stakeholders. They can create important mechanisms for collaboration and sharing of information between public sector, private sector, civil society, and academia. Discussions with these parties are also important to identify and design effective responses to some of the policy questions and social challenges that will arise from AI.

Many governments in Africa have begun to take steps to promote AI in their countries:

- The government of Nigeria has taken steps to promote partnerships and stakeholder engagement towards leveraging AI's benefits. The Ministry of Science and Technology has announced the formation of a National Agency for Research in Robotics and Artificial

Intelligence (NARRAI).<sup>38</sup> The new institute will collaborate with international research bodies, enhance instruction on AI topics for thousands of students, and promote Nigeria's ability to leverage these technologies for economic growth. In March 2018, Minister of Communications Adebayo Shittu also restated his ministry's commitment to support AI stakeholders, engage in conversations to manage and explore the implications of AI, and share best practices.<sup>39</sup>

- Kenya was the first African country to launch an open-data portal to make information on education, energy, health, population, poverty, and water and sanitation, which was previously very hard to access, available to citizens.<sup>40</sup> Application development in Kenya is high, and the government wanted to support the industry's growth. The open-data portal was created in response to requests for data by local tech incubators and co-working facilities for Nairobi programmers, like iHub,<sup>41</sup> which led the government to recognise that access to public datasets is crucial for developing locally relevant AI solutions and services. So far, data from this governmental portal has been key in the development of about 100 apps.
- The South African Department of Trade and Industry as formed a Chief Directorate for Future Industrial Production and Technologies (FIP&T) in 2017 to examine the impacts of emerging digital technologies, including the Internet of Things, big data, AI, robotics, and new materials. The unit aims to build government capacity to address these challenges and partner with industry to enhance South Africa's readiness.<sup>42</sup> Science and Technology Minister Mmamoloko Kubayi-Ngubane has also said that the government aims to boost its investment in research and development, support for entrepreneurs, and skills development.<sup>43</sup>

## Academia

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Universities and research institutions are the seedbed for AI ecosystems and offer fertile ground where leading scientists and engineers can experiment and try out their new ideas.<sup>44</sup> It is also within their walls that some of the most challenging questions on the impact of the technology are debated, providing an invaluable source of reference for policymaking.

AI is increasingly gaining prominence as a specialisation in academic and research institutions across Africa. Existing programs share the common goal of fostering research that leads to the development of AI solutions and applications that will help solve some of the continent's most pressing challenges.

There are many examples of how academia in Africa are pursuing AI:

- The University of Pretoria (UP) in South Africa created the Intelligent Systems Group (ISG)<sup>45</sup>, which specialises in the theory and application of systems that perceive, reason, learn, and

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<sup>38</sup> For more information on NADER and NARRAI, see the [Federal Ministry of Science and Technology website](#).

<sup>39</sup> For more information on Nigeria's commitment to support AI, see [Federal Ministry of Communications website](#).

<sup>40</sup> [Kenya OpenData](#). Kenya has also signed on to the [Open Government Partnership](#), launched by US president Barack Obama at the UN General Assembly in September 2011.

<sup>41</sup> For more information on iHub, see [iHub website](#).

<sup>42</sup> For more information on South Africa's AI programme, see [Department of Trade and Industry website](#).

<sup>43</sup> For more information on South Africa's investments, see [government website](#).

<sup>44</sup> Accenture, "Artificial Intelligence: Is South Africa Ready?", Gordon Institute of Business Science, University of Pretoria

<sup>45</sup> <https://www.up.ac.za/en/intelligent-systems/article/1950533/research-focus>

act intelligently. The aim of the group is to create real-world intelligent systems applicable in the South African context. Its areas of research focus include digital image processing and computer vision; music and AI; radio systems planning; and remote sensing. The members of the ISG collaborate with centres and institutes around the world, including Cambridge University Engineering Department; the United States Office of Naval Research; and the United States United States, Space and Naval Warfare Center.

- Strathmore University (Strathmore) in Nairobi has established the @iLabAfrica Research Centre, which seeks to promote cutting-edge research on emerging technologies such as Big Data, Artificial Intelligence (AI), Blockchain Technology, Cyber Security, Internet of Things (IoT) and Cloud Services to achieve development goals and contribute toward Kenya's Vision 2030.<sup>46</sup> It aims to provide direction for academic researchers and technology experts in Kenya to collectively innovate and develop applications in areas such as energy, banking, healthcare, education, and transport among other sectors as well as champion development of local technology ecosystem. @iLabAfrica has formed a research group devoted to machine learning and intelligent systems. The group focuses on exploring high-impact areas of bioinformatics, natural language processing, and e-learning.<sup>47</sup>
- Dedan Kimathi University of Technology (DeKUT) in Nyeri, Kenya, focuses on research, innovation, technology transfer, entrepreneurship, and quality education to contribute to the attainment of national development goals. The DeKUT recently won a grant for a project titled "Developing Entrepreneurial Universities in Kenya". The project involves the development of a Science and Technology Park (STP), which will be a key engine for development, incubation and commercialisation of technology developed in DeKUT. Further, DeKUT aims to leverage research and innovation to create intellectual property (IP) rights, spin-off companies and stimulate entrepreneurship and job creation to promote sustainable economic growth.<sup>48</sup>
- The University of Lagos recently launched the first AI Hub in Nigeria. The Hub will serve as an avenue for developing the AI cycle in the country by focusing on deep learning and encouraging young talent discovery within the innovation and data analytics space. Mentors and lecturers from both the academic and tech community will be invited to support students. The AI Hub will be heavily focused on tools to collect data, which is essential for the development of the technology.<sup>49</sup>
- The Centre for AI Research (CAIR) in South Africa is a research network that aims to contribute to South Africa's digital transformation, strengthen the country's economic competitiveness and enable an enhanced quality of life for all South Africans through cross-disciplinary research and capacity building. It has nodes at five South African universities: the University of Cape Town, University of KwaZulu-Natal, North-West University, University of Pretoria and Stellenbosch University.<sup>50</sup>

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<sup>46</sup> [The Kenya Vision 2030](#) aims to transform Kenya into a newly industrialising, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment.

<sup>47</sup> For more information on @iLabAfrica research group, see [Strathmore University website](#).

<sup>48</sup> For more information on the STP, see [STP website](#).

<sup>49</sup> "[Data Science Nigeria opens 1st AI Hub in Unilag](#)", *The Guardian*, 6 June 2018.

<sup>50</sup> For more information on the CAIR, see [centre website](#).

## Industry

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Industry is key to the creation of a thriving AI ecosystem in Africa as the main developers of AI technology. From established players and entrepreneurs to startups, and SMEs, industry creates innovative products; provides invaluable knowledge, insight, and expertise to government for effective policymaking; and contributes to the development of local talent and skills for Africa's growing youthful population.<sup>51</sup> There is also a large workforce that will need to be re-skilled to adapt to the new reality that AI and other technological developments will bring about. Strategic partnerships between African governments and industry can ensure Africa's population develops the right skills. All parties benefit when the right mechanisms are in place to enable collaboration and knowledge transfer between the public sector, academia, and industry.<sup>52</sup>

Africa has proved fruitful ground for AI startups. Several newly formed companies across the continent have attracted investor interest and are providing AI tools that help African industry and governments provide better services:

- SyeComp, based in Ghana, focuses on enhancing agriculture through ICT and advanced geospatial solutions, research and knowledge management. It specialises in the acquisition, processing, analysis and synthesis of geospatial data from satellites and multispectral drone sensors for various applications using geographic information systems (GIS) and remote sensing (RS) technology. SyeComp provides support for various actors across and along the value chains in new dynamics of gathering multispectral and hyperspectral image data and disseminating information through multiple channels to gain relevant insights.<sup>53</sup>
- DataProphet is a South African startup focused on machine learning solutions for business. Its early work has focused on the finance and insurance sector, designing solutions such as predictive analytics and conversation agents. The company, now four years old and already beginning to turn a profit, is also expanding into industrial and fast-moving consumer goods sectors, including international clients.<sup>54</sup>
- Kudi is another startup based in Nigeria, which has developed a chatbot for the financial sector. It allows users to make payments and send money. Their technology leverages AI to make sense of user requests, conduct conversations, understand user spending habits, and prevent fraud.<sup>55</sup>
- Numberboost, a South African company, has been working with a non-profit that manages many mobile HIV clinics to give access to patients in different rural communities. To do so, it

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<sup>51</sup> With 200 million people aged between 15 and 24 (the youth bracket), Africa has the youngest population in the world. The current trend indicates that this figure will double by 2045, according to the 2012 [African Economic Outlook](#) report prepared by experts from the African Development Bank (AfDB), the UN Development Programme (UNDP), the UN Economic Commission for Africa (ECA) and the industrialised countries' Organisation for Economic Cooperation and Development (OECD), among others.

<sup>52</sup> See subsequent sections for recommendations on what governments should do to have access to industry's expertise, including entering into partnerships and putting in place mechanisms to enable collaboration and knowledge transfer between government, academia and industry.

<sup>53</sup> For more information on SyeComp, see [company website](#).

<sup>54</sup> For more information on DataProphet, see [company website](#).

<sup>55</sup> For more information on Kudi, see [company website](#).

implemented an algorithm to spatially optimise the scheduling of the clinics and also built a USSD clinic booking system. Numberboost is currently working on an African language SMS chatbot to enable patients to ask basic medical questions.<sup>56</sup>

Moreover, established industry players have access to resources — that are often unavailable to government, academia, and other smaller players — to provide guidance and investment for local entrepreneurs, startups, and SMEs and fund research contributing to the formation of African talent and the development of the local AI industry.<sup>57</sup> Global industry has also made significant investments to conduct research and develop AI in Africa, efforts that should be leveraged and encouraged by governments:

- Microsoft created the Research PhD Scholarship Programme to support research collaborations between academics in the Europe, Middle East, and Africa (EMEA) region with researchers at the Microsoft Research Cambridge Lab. Projects accepted to the programme involve research on AI, infrastructure for the cloud, the future of work, and biological computation.<sup>58</sup>
- IBM Research Africa (IBM-RA) in Kenya and South Africa is the first commercial technology research facility in Africa conducting both applied and far-reaching exploratory research. It seeks to drive innovation by developing commercially-viable solutions to transform lives and spark new business opportunities in key areas such as water, agriculture, transportation, healthcare, financial inclusion, education, energy, security and e-government.<sup>59</sup>
- Google recently announced the opening of a Google AI Research Centre in Africa, which will be located in Accra, Ghana. The centre will be dedicated to AI research and its applications, looking to push the boundaries of AI while solving challenges in areas such as healthcare, agriculture, and education. It will bring together top machine learning researchers and engineers and will seek to collaborate with local universities and research centres, as well as work with policy makers on the potential uses of AI in Africa.<sup>60</sup>

Africa's emerging tech industry is helping to bridge the gap with developed economies by using technology as a catalyst for African growth. Tech hubs play an essential role in this regard: they foster the growth of the tech startup landscape by offering these companies space, services, and creating vibrant networks and communities of stakeholders (including startups, partners, investors) specifically targeted at helping early stage tech companies thrive (for example, by providing guidance or investment). Some active tech hubs in Africa include:

- The GSMA's Ecosystem Accelerator Innovation Fund provides selected startups in Africa and Asia with grant funding and the opportunity to partner with mobile operators in their markets to help scale their products and services into sustainable businesses.<sup>61</sup>

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<sup>56</sup> For more information on Numberboost, see [company website](#).

<sup>57</sup> For example, according to a GSMA study, 49 percent of tech hubs in Africa have partnerships with companies like Microsoft and Google.

<sup>58</sup> For more information on PhD scholarship programme in EMEA, see [Microsoft website](#).

<sup>59</sup> For more information on IBM-RA, see [IBM website](#).

<sup>60</sup> For more information on the Google AI Research Centre in Africa, see [Google website](#).

<sup>61</sup> For more information on the GSM Ecosystem Accelerator Innovation Fund, see [fund website](#).

- XL Africa focuses on helping companies that use emerging technology for both social and financial gains. They support later stage digital solutions from any sector vertical, with services or products available on the market now.<sup>62</sup>
- The MEST incubator, originally based in Accra, this year it launched plans to extend its presence across Africa. Founded in 2008, MEST operates as a training programme and seed fund for African innovators to build successful commercial tech companies. The incubator currently has offices or on-the-ground presence in Ghana, Nigeria, Kenya, South Africa, and Côte d'Ivoire, where it actively recruits. MEST is in the process of opening physical incubator spaces in multiple countries.<sup>63</sup>

## Civil Society

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Though sometimes overlooked, civil society has a vital role in ensuring an AI ecosystem is robust and responsible. It can play an important role in collecting, disseminating, and analysing data for use by government (such as agenda setting and policy development), industry, and academia.

Civil society can act as watchdog to hold government and industry accountable and ensure they fulfil their responsibilities. In this same vein, civil society also has an important role in calling attention to the ethical and social implications that must be addressed in the development of AI, ensuring that it is human-centred and capable of delivering tangible benefits for the African population.

Moreover, civil society can play the role of an intermediary between different stakeholders and foster collaboration. It can also be a vehicle for inclusion and representation, voicing the concerns, needs, and expectations of diverse groups across society.

Some examples of the important work that civil society organisations are doing around AI in Africa include the following:

- Data Science Africa (DSA) is a non-profit knowledge sharing professional group that brings together leading researchers and practitioners working on data science methods and applications relevant to Africa, as well as providing training to students. Since 2013, DSA has organised conference, workshops, and summer schools on machine learning and data science across East Africa, providing an avenue for researchers to present work demonstrating the application of these techniques to problems relevant in African. For 2018, DSA is expanding to West Africa.<sup>64</sup>
- Think Tank Initiative (TTI) supports 18 think tanks in Sub-Saharan Africa, working on diverse policy issues. One of these is the Science, Technology and Innovation Policy Research Organisation (STIPRO), based in Tanzania. Its mission is to improve human capacity in science, technology and innovation (STI) policy research as well as to raise awareness among government officials and parliamentarians of the critical role of this research for evidence-

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<sup>62</sup> For more information on XL Africa, see [company website](#).

<sup>63</sup> For more information on MEST, see [company website](#).

<sup>64</sup> For more information on DSA, see [organisation website](#).



based STI policies. STIPRO's research programme focuses on linking food security, agricultural and industrial development, health, technology, and the environment.<sup>65</sup>

- The Machine Intelligence Institute of Africa (MIIA) is a non-profit organisation that seeks to build a strong and innovative machine intelligence and data science community to solve African problems, support entrepreneurial activity, and help drive long-term inclusive and sustainable scientific, technological and socio-economic development on the continent. Since 2015, it has served as a critical networking platform for AI professionals. It aims to bring together a critical mass of resources, promote and sponsor learning activities, and strengthen scientific and technological excellence, mentoring and collaboration on the continent.<sup>66</sup>
- The African Capacity Building Foundation (ACBF), is the African Union's Specialised Agency for Capacity Development. It advises and supports African countries, regional economic communities, and institutions on decisive steps to develop the practical skills urgently required for the continent's economic transformation.<sup>67</sup>

## International Community

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International organisations support governments through policy analysis, dialogue, and multilateral commitments. They provide forums for sharing of experiences and best practices, which enables governments to approach issues from a common basis of understanding, reach consistent outcomes, and reduce the risk of irreconcilable positions on important issues. For AI, such cohesion on key issues will ensure the technology is used for the benefit of humanity.

AI is an area in which international organisations are beginning to work. Among others, the work of the following organisations will be useful for African governments in defining domestic AI policy:

- The African Development Bank (ADB) has partnered with Microsoft to launch the Coding for Employment Programme,<sup>68</sup> with the goal of preparing African youth for tomorrow's jobs while unleashing the next generation of African digital innovators.<sup>69</sup> The programme will be launching in Côte d'Ivoire, Kenya, Nigeria, Rwanda, and Senegal. In addition, it will establish 130 Centres of Excellence across Africa to help bridge the skills gap.
- The Organisation for Economic Cooperation and Development (OECD) is reviewing the economic and social impacts of AI technologies and applications, as well as the implications for policy. The organisation has launched an Expert Group on AI in Society for multi-stakeholder discussions to scope principles that will foster trust in and adoption of AI, and is actively conducting consultations to take stock of existing principles and best practices. The OECD is planning to launch a policy observatory in 2019 to ensure the beneficial use of AI.<sup>70</sup>

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<sup>65</sup> For more information on TTI, see [organisation website](#).

<sup>66</sup> For more information on MIIA, see [institute website](#).

<sup>67</sup> For more information on the ACBF, see [foundation website](#).

<sup>68</sup> For more information on Coding for Employment Program, see [African Development Bank Group website](#).

<sup>69</sup> ADB aims to upskill 50 million youth and create 25 million jobs in agriculture, ICT and other key industries across Africa by 2025 through its Jobs for Youth in Africa Initiative, of which the Coding for Employment Programme is a key part.

<sup>70</sup> For more information on OECD's AI vision, see [OECD website](#).

- The United Nations (UN) is leading discussions in many venues on its implications for member states.
  - International Telecommunications Union (ITU) is also conducting work to foster inclusive global dialogue on beneficial AI, focused on impactful AI solutions able to yield long-term benefits and help achieve the UN’s Sustainable Development Goals (SDGs).<sup>71</sup>
  - International Labour Organisation conducts extensive work to research, raise awareness, and share best practices on the “future of work,” especially as it is impacted by automation and artificial intelligence.<sup>72</sup>
  - The UN Interregional Crime and Justice Research Institute has maintained a Centre for AI and Robotics since 2016 in the Hague, which gathers information and knowledge from experts to educate and engage stakeholders, including policy-makers on its implications for security.<sup>73</sup>
  - The UN Commission on Science and Technology for Development (CSTD) and the Conference on Trade and Development, conduct work on the role of AI in achieving inclusive and sustainable economic growth. The latter has partnered with the Brazilian International Chamber of Commerce to explore the potential of AI to help trade negotiators, especially those from developing countries with fewer resources to devote to trade negotiations.<sup>74</sup>
- Pulse Lab Kampala (Pulse Lab)<sup>75</sup> in Uganda is the first innovation lab in Africa, and the third lab of the United Nation’s Global Pulse network.<sup>76</sup> It works through partnerships and in alliance with the Ugandan government to support the UN Country Team and the Government of Uganda to achieve the Global Goals for Sustainable Development.<sup>77</sup> Pulse Lab brings together data scientists, data engineers, partnership specialists, academics and technical experts to generate high impact data analysis tools to address development challenges.

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<sup>71</sup> For more information on AI for Good Global Summit 2018, see [ITU website](#).

<sup>72</sup> For more information on The Future of Work Centenary Initiative, see [ILO website](#).

<sup>73</sup> For more information on UNICRI Centre for Artificial Intelligence and Robotics, see [UNICRI website](#).

<sup>74</sup> For more information on trade negotiations and AI, see [UNCTAD website](#).

<sup>75</sup> For more information on Pulse Lab Kampala, see [UN Global Pulse website](#).

<sup>76</sup> For more information on the United Nation’s Global Pulse Network, see the [Global Goals website](#).

<sup>77</sup> For more information on the United Nation’s Global Pulse Network, see the [Global Goals website](#).

## WHAT ARE THE CHALLENGES?

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The opportunities to apply AI in key sectors are numerous, and stakeholders are already working to achieve these opportunities. However, there are a number of barriers that will keep Africa lagging behind in the AI race if not addressed. These range from lack of supportive infrastructure, to lack of required skills and lack of quality data to fuel AI.

### Complementing Labour in New Ways

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Many are concerned that AI will eliminate jobs, worsen inequality, or erode incomes. Many studies have been conducted to examine this issue. While most do find that some jobs will disappear, many more will be transformed into jobs that require different skill sets, while other entirely new jobs will be created. Many jobs will continue to require uniquely human skills that AI and machines cannot replicate, such as creativity, collaboration, abstract and systems thinking, complex communication, and the ability to work in diverse environments.

Throughout history, the emergence of new technologies has been accompanied by warnings about human redundancy. However, in reality new technologies have created millions of more specialised, meaningful and skilled jobs.<sup>78</sup> For example, between 1982 and 2002, despite the spread of the personal computer which automated certain jobs, employment grew significantly faster in occupations that used computers than those that did not. Automation enabled workers to focus on other parts of their jobs, which increased demand for human workers to handle higher-value tasks that had not been automated.<sup>79</sup> Similarly, the introduction of the automatic teller machine (ATM) increased the number of bank tellers employed. While a human no longer had to spend time counting out bills, tellers could focus on providing a better customer service experience and bank's operating costs fell, allowing them to open more branches and hire more tellers.<sup>80</sup>

Additionally, entirely new jobs will be created. Consistently over time, technology has proved to be “a great job-creating machine”.<sup>81</sup> Major, transformative technologies, as AI will prove to be, are capable of building entirely new sectors of the economy. Some of the new areas of economic opportunity and categories of employment will obviously be high technologies jobs closely linked to the creation, implementation, and maintenance of AI-based applications, including in software development, networking, and cybersecurity.

Job growth, however, will not just be limited to high technology. AI will fuel the growth of many non-tech jobs. For example, the Internet-enabled “gig economy” is enabling new avenues for individuals to earn income and transforming the way individuals find and consume services. Across Africa, new platforms such as Upwork, Freelancer, and Fiverr are creating new opportunities for Africans to provide services to local and global customers, especially focusing on digital content development, marketing, graphics, and web development. In Nigeria, one thriving segment of the emerging gig

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<sup>78</sup> Microsoft, *The Future Computed*, p. 92

<sup>79</sup> “[Automation and Anxiety: Will Smarter Machines Cause Mass Unemployment?](#)” *The Economist*

<sup>80</sup> “[What the story of ATMs and bank tellers reveals about the ‘rise of the robots’ and jobs](#)” *A Ideas*.

<sup>81</sup> [Technology and People: The Great Job-Creating Machine](#), Deloitte.

economy is beauticians who provide make-up and hair dressing services.<sup>82</sup> Apps such as 'Beauty on TApp' are a new avenue to connect customers to the best services for them and support the growth of small and women-owned business.<sup>83</sup> Nigerian based e-commerce site Jumia employs approximately 10 000 commission-based sales agents across Nigeria to facilitate sales to their friends and neighbours, including training in customer service and how to use the platform.<sup>84</sup> We can expect more of these types of jobs, such as in healthcare, education, training, and hospitality. It's no surprise then that some of the top trending professions in Africa include not just data centre managers, and 3D designers, but also entrepreneurs, trust officers, health and medical practitioners, and care and personal services.<sup>85</sup>

Policy makers must also recognise that apprehensions regarding how workers will adjust to these changes are valid and must be responded to effectively. First, policy makers should be clear to highlight AI's brings tangible benefits, not just its drawbacks. Second, policy makers need to actively address and pre-empt the downsides of AI through active labour market policies to help connect displaced workers with new employment opportunities, as well as to access to new training opportunities so that workers are better placed to succeed in new types of employment. To this end, policy makers should identify the groups at high risk of displacement and create strategies that focus on reintegrating them into the economy. Job creation in new areas needs to be promoted, as these would have the potential of absorbing a large portion of the workforce that may find itself redundant due to increasing automation.

## Getting Students the Right Skills

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Despite the fast growth of AI technology, few countries – including developed countries - have the education and skills systems in place to equip their workers to reap the benefits. Applications of AI are poised to change the nature of work in ways education systems are not yet prepared to grapple with. A recent study by EY and the Indian National Association of Software and Services Companies (NASSCOM) found that by 2022, 9 percent of the workforce will be engaged in entirely new jobs that do not exist today, and a further 37 percent will be deployed in jobs that have radically changed skillsets.<sup>86</sup> These jobs of the (near) future will be different. Routine tasks will increasingly be executed by or with the aid of AI-driven processes, meaning that workers can be more productive, but also will have to shift to cognitive aspects of those same tasks.<sup>87</sup>

However, identifying just what specific skills will be needed is challenging. Economic transformation can happen at different rates in different sectors, and we do not always know the needs of new types of jobs. But we do know that they will centre on "human" aspects including problem solving, creativity,

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<sup>82</sup> "[Nigeria's Gig Economy](#)," Connect Nigeria.

<sup>83</sup> For more information on Beauty of TApp application, see [Nigeria Communications Week website](#).

<sup>84</sup> Katharina Neureiter, "[Can the gig economy help create jobs in Africa?](#)" *Observer Research Foundation*, July 2018.

<sup>85</sup> Richard Samans, and Saadia Zahid, "[The Future of Jobs and Skills in Africa: Preparing the Region for the Fourth Industrial Revolution](#)," *World Economic Forum*, May 2017, Pg 14,

<sup>86</sup> "[Future of Jobs in India](#)," EY.

<sup>87</sup> "[Automation and Anxiety: Will Smarter Machines Cause Mass Unemployment?](#)" *The Economist*; [Technology and People: The Great Job-Creating Machine](#), Deloitte.

communication, and caregiving.<sup>88</sup> To effectively harness the potential of AI, workers need access to better institutions and mechanisms to learn these skills.

First, at the primary and secondary education level, education needs to refocus on core general skills and the specific AI-related technical skills. Improved STEM (science, technology, engineering, and math) skills, including baseline capabilities in mathematics and types of coding, will be important to allow people to take the high technology jobs that will arise out of AI. Beyond building a workforce capable of building AI tools, it is also important to build a workforce that is an effective *user* of AI tools, meaning fundamental digital literacy, problem solving, and collaboration skills are crucial.<sup>89</sup>

Struggling African education systems also need more support. While Africa as a region has made impressive gains in educational enrolment at every level in the last few decades, funding has not caught up, leading to an average pupil to student ratio of 42:1 across the continent. Skills outcomes, between those who attend school and those who do not, do not significantly differ, indicating that schools are not teaching them practical skills.<sup>90</sup> Shortages of STEM subject teachers are especially acute and contribute to low uptake of STEM subjects by students after compulsory requirements.<sup>91</sup> Increase collaboration between industry and academia can help fill the gap, creating channels of communication between faculty and industry to promote exchange of ideas and expertise. Innovative technology-based tools can also help existing teachers do more with less. Innovative approaches to teaching — such as decentralised teaching mechanisms leveraging digital content and communications platforms — can enhance the quality of education they deliver to students economically.

African higher education institutions also need to adapt to help close the skills gap. Given the lack of sufficient STEM focus in secondary education, putting more focus on STEM subjects at the tertiary level can be one way to address gaps not adequately addressed at the secondary level.<sup>92</sup> However, less than 25 percent of graduates from Africa’s higher education institutions focus in STEM, feeding a continent-wide deficit in skilled professionals, a deficit with key detrimental economic impact.<sup>93</sup>

Finally, given the enormity of gaps in current education systems, the private sector has a critical role to play in elevating the skills of African citizens. Re-skilling of the current workforce will require better integration of government and private sector skilling initiatives to open new paths for individuals. In South Africa, for example, despite a nearly 50 percent youth unemployment rate, three quarters of companies struggle to fill engineering roles.<sup>94</sup> An inadequately skilled workforce is also blamed as a “major constraint” on the growth of 41 percent of firms in Tanzania, 30 percent in Kenya, 9 percent in South Africa, and 6 percent in Nigeria.<sup>95</sup> Encouraging or incentivising apprenticeship programmes —

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<sup>88</sup> [Technology and People: The Great Job-Creating Machine](#), Deloitte.

<sup>89</sup> [“Education must transform to make people ready for AI”](#), *Financial Times*, December 12 2017

<sup>90</sup> [“State of Education in Africa Report 2015”](#), The Africa-America Institute, 2015.

<sup>91</sup> Professor Leon Tikly, Marie Joubert, Dr. Angeline M. Barrett, Dr. Dave Bainton, Leanne Cameron, Helen Doyle, [“Supporting Secondary School STEM Education for Sustainable Development in Africa”](#), University of Bristol, May 2018.

<sup>92</sup> *Ibid.*

<sup>93</sup> [“STEM Education and African Development”](#), Africa Policy Review.

<sup>94</sup> [“3 steps to fix education in Africa”](#). World Economic Forum, 8 June 2015.

<sup>95</sup> [“The Future of Jobs and Skills in Africa”](#), World Economic Forum, May 2017.

as Germany has done, for example — will help companies both develop the human capital they need and arm workers with the skills demanded by the labour market.

Open learning platforms facilitated by the private sector will also play an instrumental role in large scale dissemination of in-demand skills for many in the workforce. Many global tech companies already realise and have launched training platforms, including AWS Educate or Salesforce Trailhead. Online and self-learning platforms can connect learners to the best universities and institutions around the world. While taking measures to ensure quality, uniformity, and mutual recognition of certifications, promoting use of these platforms will be crucial. Governments should encourage participation in and recognition of qualifying online resources who have the resources.

## Reaching All Citizens

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AI depends on high quality broadband. This creates an obvious problem for Africa: given the continent's many connectivity challenges, people must be brought online before they can fully leverage the benefits of AI.

There are an estimated 267 million individuals not using the Internet in Africa, and approximately 53 million households.<sup>96</sup> Within these numbers, there are substantial inequalities: while approximately 22 percent of urban populations have access to the Internet, this number falls to just 10 percent for rural populations. There are also similar divides between men and women, the youth and mature populations, and upper versus lower income groups.<sup>97</sup> Without sufficient connectivity, entire regions will be excluded from all that this technology can to offer.

The inter-related issues of insufficient infrastructure and lack of affordability are the key obstacles. An estimated 30 percent of Sub-Saharan Africa's population is beyond the reach of even the backbone network, let alone last mile links to access the Internet.<sup>98</sup> African countries also have the most expensive broadband in the world. According to the Alliance for Affordable Internet (A4AI), the first gigabyte of mobile data cost 9.3 percent of the average income in 2016, compared to 3.7 percent for Latin America and 2.5 percent for Asia. Of the 59 developing countries studied, African countries occupied 9 of the 10 lowest slots regarding affordability, with costs ranging from 12 percent to 44 percent of income.<sup>99</sup>

Governments should seek to develop and implement policies to enhance connectivity and affordability. This is especially urgent in rural areas, where the lack of broadband is most pressing, but also where applications in the agricultural sector have significant potential. While in some cases public support and direct investment may be needed, private investment is critical to ensure adequate infrastructure is in place and should be encouraged. Enabling new wireless technologies may also be an important piece of the puzzle to connect users as quickly and cheaply as possible, bypassing in some cases expensive terrestrial infrastructure.

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<sup>96</sup> I. Philbeck, "[Working Together to Connect the World by 2020: Reinforcing Connectivity Initiatives for Universal and Affordable Access](#)", *Broadband Commission*, p.8,

<sup>97</sup> "[World Development Report 2016: Digital Dividends](#)", World Bank, 2016, p. 9,

<sup>98</sup> J.M. Garcia and T. Kelly, "[The Economic and Policy Implications of Infrastructure Sharing and Mutualisation in Africa](#)," *World Bank Group*, p.16.

<sup>99</sup> For more information on New Broadband Pricing Data, see [A4AI website](#).

## **Ensuring AI is Used Ethically**

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AI opens new frontiers for economic transformation — and morality. Ethically built and used AI could help promote equality and fairness, but poor or malicious design risks exacerbating existing social problems in new ways.

To ensure AI can benefit all and create the most societal value, stakeholders need to have open conversations about the ethical dimensions of this technology and take appropriate action.

### **Concentration of Power and Exploitation**

AI's ability to create a richer society could be used to contribute to the accumulation of wealth in a few hands, thereby increasing inequality and threatening political unrest. Similarly, AI could be used to gather and analyse the data individuals make available in a growing number of categories, concentrating an increasing amount of predictive power in the hands of a few companies. This could allow exploitation or a move from predicting behaviour to directing it.

Moreover, these practices could easily lead to discrimination based on age, gender, ethnic background, health conditions or social background. Thus, while commercially valuable, the use of AI for these purposes raises important ethical concerns.<sup>100</sup>

These issues are not only ethical, however; they are being discussed in the context of privacy and antitrust regulation. Around the world, regulators and policy-makers are debating what data tech firms should be able to collect and store; the purposes for which they should be able to use that data; the degree of transparency they should provide about what they do with it; the information they should provide to customers on the risks of providing data; and even their responsibility in educating customers. Further, there are important developments globally on antitrust policy and regulation as governments look into this area of law to find ways to curb the concentration of data ownership.

### **Quality of Data and Biases**

AI promises rational decision-making, circumventing the discrimination and biases inherent in many human decisions. A 2014 White House report indicated that algorithmically-driven processes have great potential to drive innovations that increase fairness, expand access to economic opportunity for low income communities, reduce biases in hiring and classrooms, and support better outcomes for students.<sup>101</sup> However the report also warned of the potential of encoding discrimination in automated decisions.<sup>102</sup>

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<sup>100</sup> And this is not only limited to the private sector; use of AI by some governments gives rise to equal ethical concerns. For example, some are using AI to infer the activities of terrorists and other organised criminals. Police forces use advanced predictive analytics to predict a higher chance of crime rates in certain areas on certain days or times in the day. Surveillance cameras in streets are connected to analytical software that is engineered to detect behavioural patterns indicating trouble. These can lead to violations of human rights and legal principles.

<sup>101</sup> ["Big Data: A Report on Algorithmic Systems, Opportunity, and Civil Rights"](#), The Obama White House, May 2016.

<sup>102</sup> ["Big Data: Seising Opportunities, Preserving Values"](#), The Obama White House, May 2014.



Machine learning processes are only as good as the data that are fed to them. This is why biases, deeply-rooted in human society, can and do creep in. AI algorithms integrate biases inherent in data, or even in the person who built the process, further perpetuating existing societal biases.<sup>103</sup> This is particularly the case when working with population or personal data. Therefore, some of the most pressing challenges in this regard include:

- Ensuring algorithms are properly trained to produce equitable results when characteristics of a minority community are systematically undercounted or misrepresented;
- Mitigating the impact on decision-making when one aspect – for example income – is closely correlated with another characteristic such as ethnicity, even when that latter characteristic is not explicitly coded; and
- Averting biases driven by human-programmed parameters on the relationships between different data fields.<sup>104</sup>

This is highly relevant for Africa, where users are likely to import machine-learning algorithms developed and trained elsewhere with data that may not recognise or carry bias towards large segments of the African population.<sup>105</sup> This could happen, for example, in the context of applications for loans or credit to banks: if algorithms trained on biased data (for example, data obtained from other countries or regions with different realities) are used to make decisions on whether persons are eligible for a loan or credit, they may consistently discriminate against certain groups based on socio-economic background or ethnicity.

As a first step in dealing with these challenges, African stakeholders should work together to ensure AI applications are developed by teams with diverse demographic, gender, ethnic, and socio-economic backgrounds.<sup>106</sup> This is key to avoid cognitive bias. According to Microsoft’s Brad Smith: “If we only have a small group of men design AI, then we are going to have computers that behave like a small group of men.”<sup>107</sup>

Continued technical innovation will be key to solving many of these challenges as long as it integrates consideration of ethical implications of systems that they build. It’s also true that the risks of AI stem as much from human misunderstanding of and overreliance on AI systems as they do from limitations in the systems themselves. Therefore, developers must always strive to fully and effectively communicate with users and regulators to ensure adequate understanding of the technology, its use, and the risks associated with it.

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<sup>103</sup> These biases arise because the training data needed to develop and train machine-learning algorithms are themselves biased. To understand why this is so, it is important to remember that machine-learning algorithms are trained by feeding them data (called training data) and letting them learn to find patterns in it. Once the algorithm learns the underlying patterns of the training data, it needs to be tested on fresh data that it has never seen before.

<sup>104</sup> Kathryn Hume, “[Artificial Intelligence is the future — but it’s not immune to human bias](#)”, Maclean’s, December 27 2017.

<sup>105</sup> Users could be anything from governments to businesses and civil society that make use of this technology for a variety of different purposes.

<sup>106</sup> For more information on “the Future Computed”, see [Microsoft website](#).

<sup>107</sup> On this point, it is important to recall that most countries already have existing regulations to address issues such as discrimination and prejudice. AI processes are not exempt and ultimately a human must be accountable to comply with legal constraints on decision making. When appropriately accountable and thoughtfully constructed to mitigate human bias, AI can fulfil its promise of being a neutral aid to consequential decisions and enable innovative tools to empower sensitive communities.

There are no legal mandates or rules that can yet solve these problems and, in an emerging field, the consequences cannot always be foreseen. Therefore, to ensure AI remains human-centric and promote accountability, companies developing or using AI should promote ethical debates that lead to codes of conduct based on principles such as:<sup>108</sup>

- Fairness – AI systems should treat all people fairly
- Reliability – AI systems should perform reliably and safely
- Privacy and Security – AI systems should be secure and respect privacy
- Inclusivity – AI systems should empower everyone and engage people
- Transparency<sup>109</sup> – AI systems should be understandable
- Accountability - AI systems should be accountable

## Overcoming the Data Desert

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AI depends on data: the more data is available, the better and more effective results this technology will deliver. A 2013 study estimated that open data applied in the education, transportation, consumer products, electricity, oil and gas, health, and consumer finance sectors could generate an additional USD 3-5 trillion annually in economic value.<sup>110</sup> This number would likely rise in light of more refined applications of AI. However, in regions of the world such as Sub-Saharan Africa, access to large sets of data is limited. Therefore, solutions must be found to ensure AI can bring the most benefit to its population.

Difficulties with availability of data in Africa is well recognised in the context of development, where quality data is indispensable indicators of progress towards the Sustainable Development Goals (SDGs) and an important input for those designing development programs. The UN Economic Commission for Africa (UNECA) describes national data ecosystems in Africa as at “nascent stages of the African data revolution”.<sup>111</sup> There are many sources of data in national data ecosystems, both “official,” those generated by government institutions, and “unofficial,” those generated by various academic and scientific institutions, local and international NGOs and civil society, and the private sector. Driven by commercial and technological advancements, as well as legal, political, infrastructure, and governance changes, there are an ever-increasing number of sources feeding data ecosystems in Africa.<sup>112</sup> UNECA finds that “the private sector is increasingly becoming a critical and dynamic player within African data ecosystems” through sharing of non-proprietary data, engaging in brokerage activities, and providing platforms for crowd-sourced or user generated data sources.<sup>113</sup>

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<sup>108</sup> These principles and the wider considerations on the ethical use of AI should inform law-making. Industry-led self-regulation and state regulation will be equally relevant in ensuring the technology is used to the benefit of mankind. Microsoft, Future Computed.

<sup>109</sup> Transparency is key; algorithms behind the machine learning capabilities must be justified, demonstrated and then critically accepted.

<sup>110</sup> Australian Government, Department of Communications and the Arts, Bureau of Communications Research, Open Government Data and Why it Matters: A Critical Review of Studies on the Economic Impact of Open Government Data, February 2016

<sup>111</sup> [“The Africa Data Revolution Report 2016”](#), UNECA.

<sup>112</sup> [“The Africa Data Revolution Report 2016”](#), UNECA.

<sup>113</sup> UNECA, page 21

Despite this, challenges to a more robust data ecosystem remain. UNECA points out that in 11 out of 48 African countries, statistical capacity has actually decreased over the last 15 years. A further study found that over half of African countries had not conducted a labour force survey within the last 10 years.<sup>114</sup> The Open Data Barometer, created by the World Wide Web Foundation, finds that open data initiatives in a majority of Africa's countries lack long-term commitment and sustainable resources. Other legislative and policy impediments often limit the sharing and use of data not produced by national statistical systems.<sup>115</sup>

The problem with the lack of data is also deeply political, both in some of its causes and in its effects. The quality of population data gets to the question of who or what "counts," a question with deep roots in the political economy of societies, ideologies of governments, and troubling implications in the context of AI. At a basic level, if there is insufficient data available regarding marginal communities or the informal economy, applications of AI are at risk of being blind to those aspects of society. This may result in outcomes that have unintended consequences on the economy or reinforce inequalities.

Part of the solution is to expand the data ecosystem. Government's should improve the accuracy of data they collect and share in key sectors — for example with the use of technology (such as cloud computing) by national statistical agencies to improve efficiency in the gathering, structuring and analysis of data. However, policies must also encourage the private sector and civil society to do the same. Governments can help support this by encouraging voluntary adherence to industry standards for data that facilitate interoperability of data sets, promoting data publishing principles (for example Sir Tim Berners-Lee's so-called 'five-star maturity model'),<sup>116</sup> and incentivising automated collection and sharing of certain non-proprietary data by the private sector.<sup>117</sup> Encouraging data sharing platforms, for example for publicly funded academic and scientific research institutions, will also help deepen the pool of data available to all stakeholders.

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<sup>114</sup> Conclusions of Krätke and Byiers (2014) and Mo Ibrahim Foundation (2016), cited in UNECA, page 13-14.

<sup>115</sup> Open Data Baromet/UNESCO, page 14l

<sup>116</sup> Tim Berners-Lee. 2009. [Linked Data](#) ("Five Stars").

<sup>117</sup> For additional recommendations targeted to the agricultural sector, see Global Open Data for Agriculture and Nutrition (GODAN), "[A Global Data Ecosystem for Agriculture and Food](#)", August 2016, .

## HOW CAN AFRICA PROMOTE AI?

African governments can transform the potential of AI into a reality for their citizens. While there are real challenges to overcome, there is also the potential to leapfrog others by leveraging the experience of countries that have taken a leadership role in AI.

### International Benchmarks

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The development of artificial intelligence technologies is a global race — and many countries are trying to pull ahead. Applications of AI are already being deployed by both the public and private sectors, and several countries are already well on their way towards tackling obstacles and leveraging significant benefits from this emerging technology.

A recent International Data Corporation (IDC) study estimates global spending on cognitive and artificial intelligence systems will reach USD 19.1 billion in 2018, an increase of 54.2 percent over the amount spent in 2017.<sup>118</sup> In 2018 thus far, the retail sector has surpassed banking to become the industry leader in AI spending. According to the IDC study, retail firms will invest USD 3.4 billion this year on a range of AI use cases, including automated customer service agents, expert shopping advisors, product recommendations, and merchandising for operations.<sup>119</sup> The banking industry comes in a close second with USD 3.3 billion in expenditure towards AI technologies including automated threat intelligence and prevention systems, fraud analysis, investigation, programme advisors, and recommendation systems.<sup>120</sup>

As countries around the world become increasingly aware of the potential economic and social benefits of developing and applying AI, development of AI policy frameworks and support for the AI ecosystem are on the rise, and many governments have taken an active role in facilitating the development of AI in their country. One of the driving forces behind AI advancement in several countries is the development of a national strategy to support research and development, as well as allocation of funds to realise it.

#### **Canada** Pan-Canadian Artificial Intelligence Strategy

- Leveraging a strong business environment, high quality human capital, and global openness to attract global players and drive development.
- Providing targeted financial support for startups and human capital retention.
- Developing global thought leadership on the economic, ethical, policy, and legal implications of AI.

#### **China** Next Generation Artificial Intelligence Development Plan

- Pursuing massive, all of government approach and leveraging economies of scale in a large market.

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<sup>118</sup> [IDC Study.](#)

<sup>119</sup> [IDC Study.](#)

<sup>120</sup> [IDC Study.](#)

	<ul style="list-style-type: none"> <li>• Ambitious quantitative targets for market growth across sectors and sizeable state support.</li> <li>• Using early government adoption of services to promote development, especially in healthcare, education, and security.</li> </ul>
<b>India</b>	<b>National Strategy for Artificial Intelligence</b>
	<ul style="list-style-type: none"> <li>• Building upon comparative strengths to develop high impact solutions in key niches.</li> <li>• Attracting global technology partners to conduct research and develop applications tailored to national needs.</li> </ul>
<b>Mexico</b>	<b>Artificial Intelligence Strategy Mexico 2018</b>
	<ul style="list-style-type: none"> <li>• Promoting discussion across government and private sector to identify use cases, needs, and best practices.</li> <li>• Using PPPs to improve public services and citizen participation through AI</li> </ul>
<b>UK</b>	<b>Artificial Intelligence Sector Deal</b>
	<ul style="list-style-type: none"> <li>• Agreeing joint investment and discussion of policy measures with the private sector</li> <li>• Focus on attracting talent and promoting data sharing.</li> <li>• Piloting solutions in partnership with global companies to improve public services</li> </ul>
<b>UAE</b>	<b>Artificial Intelligence Strategy</b>
	<ul style="list-style-type: none"> <li>• Putting a priority on development at the highest level of political focus</li> <li>• Investment in skills training for students and workers</li> </ul>

## Elements of an AI Strategy that Works for Africa

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Policy-makers can design policies that encourage the development of AI and incentivises innovation, while protecting citizens. To do so, African governments should consider a proactive approach and measures aimed at ensuring countries have (i) a reliable and supportive *infrastructure*; (ii) a robust *regulatory and policy framework*; (iii) a *collaborative environment* where all stakeholders can leverage each other's experience; and (iv) the right conditions for AI to developed in a *socially responsible* way.

### Supportive Infrastructure

Investment in connectivity infrastructure is inextricable from the development of AI. Access to robust, ubiquitous, and affordable broadband infrastructure is a prerequisite for AI development and uptake.

While in recent years there has been a dramatic improvement in the quantity and quality of telecommunications infrastructure, Sub-Saharan Africa still has more to do to ensure adequate connectivity infrastructure is in place.<sup>121</sup> African organisations and entrepreneurs that could be developing AI technology lack access to stable Internet connections and frequently are deficient in even more basic complementary infrastructure like electricity and roads. Without these foundations, AI's potential benefits will be limited to and enjoyed only by a few elites.<sup>122</sup>

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<sup>121</sup> World Bank Group, Africa's Pulse: An analysis of issues shaping Africa's economic future, Office of the Chief Economist for the Africa Region, April 2017, Volume 15, p. 35-43

<sup>122</sup> [World Wide Web Foundation, Artificial Intelligence: Starting the policy dialogue in Africa](#), December 2017,

A strategic approach should include plans to increase awareness of AI and assigning it appropriate weight in budgets and development planning. Governments should adopt measures — such as robust institutional and regulatory frameworks — to encourage private sector investment. These measures which are critical as they provide certainty, accountability and transparency.

African governments should also consider the merits of the public-private partnership (PPP) model for infrastructure projects. By managing risks, PPPs allow governments to access resources and valuable expertise from local and international partners, and better align private investment with public policy objectives. In the Sub-Saharan region PPPs remain few and under-developed relative to in other markets, with projects concentrated in only a few countries (namely, South Africa, Nigeria, Kenya, and Uganda) and mostly in the renewable energy sector. However, in other countries, the model has proven successful in helping to make up for low public sector investment in key areas.<sup>123</sup> African countries can benefit from the experience of such countries in developing robust PPPs that channel the necessary resources to key areas for the development of the connectivity infrastructure.<sup>124</sup>

Just as important as the physical infrastructure is the human infrastructure. As previously mentioned, an environment that develops the AI education and skills for workers is critical. If AI is to fully develop and African workers are to use it to their advantage, African governments will have to take serious steps in the near term to overcome these structural challenges through public policies and national programs that invest in skills and training, including increased resources for quality STEM instruction at all levels of education. It also requires a closer partnership with the private sector to develop initiatives and identify in-demand skills to target.

### **Regulatory and Policy Framework**

Policy can be a powerful tool for African governments to promote technological development by encouraging innovation and investment. At the same time, as leading countries have shown, government engagement and experimentation with nascent technology can also be a powerful signal of trust and support local companies. According to African stakeholders, low government engagement, particularly at the policy level, has been a hindrance, and a stronger focus will encourage an early adoption of AI.<sup>125</sup>

African governments should take a proactive approach and implement AI-friendly regulation, policies, and initiatives. There are several areas relevant to the development and AI and robust digital economies where policy-makers should focus:

- **Data privacy and security** — A data privacy and security framework that individuals can trust encourages and empowers them to use AI-based solutions that require their data to work. Data privacy and security laws should aim to protect users' data without restricting the ability to move data across borders. In drafting these laws, African regulators should look to learn

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<sup>123</sup> The World Bank has gathered information on successful approaches to the development of the public-private partnership model in diverse countries, which may be useful for Africa. For more information, see [World Bank report](#).

<sup>124</sup> For example the World Bank has gathered information on successful approaches to the development of this model in diverse countries, including developing economies, which governments would be able to access for guidance in developing their PPP regime for technology infrastructure projects.

<sup>125</sup> World Wide Web Foundation, Artificial Intelligence: Starting the policy dialogue in Africa, December 2017

from international best practice, which includes avoiding burdensome requirements which would foreclose the benefits of AI and put African companies at a disadvantage.

- **Cybersecurity** — African governments should adopt cybersecurity laws that provide for meaningful deterrence, incentivise investment, clarify legal responsibilities, and create effective and reasonable enforcement mechanisms. Additionally, authorities should help users understand and properly manage the risks inherent in using AI technology.
- **Digital strategies and cloud adoption initiatives** — Governments should develop national digital strategies and policies that foster widespread cloud adoption to democratise the use of advanced technologies.
- **Intellectual property** — Intellectual property laws that provide for clear protection and enforcement against misappropriation and infringement of technological developments, including proprietary algorithms, are indispensable to promote continued innovation and advancement in AI.
- **Procurement policies** — Public procurement regulations should enable the use of AI solutions for the provision of public services. By investing in public sector innovation, African governments will demonstrate their trust and AI and support the growth of local developers.
- **Industry-led standards and international harmonisation of rules** — IT organisations worldwide are developing international standards to ensure data portability, interoperability, and a smooth data flow. African governments should remain abreast of developments in this area and seek to adopt international standards and harmonisation rules as they become applicable.

By leaning on international best practice, African governments can develop national strategies and create a flourishing legal environment for AI. Leading actors — both other governments and the private sector — have valuable experiences to share regarding the advantages, uses and risks of AI, as well as policy approaches they have taken to address challenges and create an environment to fully benefit from this technology.

### **Creating a Collaborative Environment**

Following the example of leading countries in AI, African governments should increase cooperation and exchange of information between diverse stakeholders: academia; industry (including startups and entrepreneurs), civil society (including NGOs and think tanks); policymakers and regulators. These actors must work together — not in silos.

Such a collaborative approach encourages the sharing of expertise and perspective on AI. African government can gain a deeper understanding on the technology and rely on international best practice to address specific local and regional needs. This approach ensures that policy and regulatory action protects citizens and support the technology's development.

Governments worldwide are concerned about the major intellectual, technological, political, ethical, and social questions that will arise as AI become deeply integrated into our lives.<sup>126</sup> Local, national,

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<sup>126</sup> Accenture and Gordon Institute of Business Science, University of Pretoria, Artificial Intelligence: Is South Africa Ready?, p. 15



regional, and international collaboration can address these concerns as governments share knowledge and experience.

Collaboration is as much an orientation of openness as it is a specific policy program. African governments follow these measures to foster the local and regional AI industry:

- Integrate national and regional AI Councils with leading figures from industry, academia and government to advise on the development of AI strategies and oversee their implementation.
- Adopt open data initiatives as a way of using technology to support distributed innovation, and to make AI development more participatory and transparent.<sup>127</sup>
- Develop frameworks that enable government and industry to work together in technology projects, including public-private partnerships.
- Create national and regional “AI labs” that gather top researchers and thought leaders working in the development of the technology as well as on its implications for policy and law-making purposes.<sup>128</sup>
- Adopt policies in partnership with universities and the private sector to attract and retain people with AI skills. For example, African governments could:
  - Work with industry and academia to develop and run specialised fellowships and programs (such as Masters in AI) that prepare the national workforce to respond to businesses current and future skills needs.
  - Create incentives for industry to fund educational programs at all levels, from basic skills to masters and doctoral programmes.
  - Consider modifications to visa allowances to allow foreign nationals to work in jobs in science and digital technology.<sup>129</sup>
  - Work with other stakeholders to organise networking events that allow experts to share knowledge and collaboration across countries. Some countries in the region are already doing this, such as Nigeria (Data Science Lagos), Kenya (Data Science Nairobi) and South Africa (Machine Intelligence Institute of Africa).<sup>130</sup> These will also be key to ensure Africa’s young, ambitious, and entrepreneurial-minded population find what they need in Africa, rather than go to other countries to achieve their goals.
- Consider joining international initiatives and partnerships that gather experts in the field and thought leaders to contribute to the development of AI for the benefit of humanity (such as Partnership On AI<sup>131</sup> or City.AI).<sup>132</sup>

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<sup>127</sup> Access to free, open, and anonymised, curated datasets is essential to train algorithms and support machine learning. It can also help improve accountability in AI development. Further, by encouraging stakeholders to use open government data in AI, the quality of data is improved.

<sup>128</sup> A recent example of this is the Italian CINI National AI Lab, which gathered [600 AI researchers to push the country’s AI industry forward](#).

<sup>129</sup><sup>129</sup> “Brain drain” is a significant concern in this sector (as with other sectors in low- and middle-income countries), as local talent is systematically recruited by large US and European companies working on AI, including Google, Facebook, and Apple. World Wide Web Foundation, Artificial Intelligence: Starting the policy dialogue in Africa, December 2017

<sup>130</sup> World Wide Web Foundation, Artificial Intelligence: Starting the policy dialogue in Africa, December 2017

<sup>131</sup> [Partnership on AI](#)

<sup>132</sup> [City.AI](#). For more information on the Tech in Ghana Conference, see [event website](#).

## **AI for Good**

AI can drive both economic and social progress and help countries achieve national objectives like inclusive growth and development. But to achieve this, the technology must be developed in a way that is human-centred. African governments should consider the wider impacts of AI and implement policies accordingly. Responsible AI systems must be aligned with ethical values while empowering consumers.

There is a role for policy in ensuring that data and algorithms are used responsibly, and governments should support the multi-stakeholder development of codes of conduct. Such codes should be cross-sector and based on shared principles. A recent report of the UK House of Lords suggests some principles that can form such a basis:

- i. AI should be developed for the common good and benefit of humanity;
- ii. AI should operate on principles of intelligibility and fairness;
- iii. AI should not be used to diminish the data rights or privacy of individuals, families or communities;
- iv. all citizens should have the right to be educated to enable them to flourish mentally, emotionally and economically alongside artificial intelligence;
- v. the autonomous power to hurt, destroy or deceive human beings should never be vested in artificial intelligence.<sup>133</sup>

Further, governments should ensure that transparency, liability, accountability, justification, and redress for decisions are at the heart of the development and application of AI. These principles are essential to foster trust in AI and ensure its true potential can be realised by all. This is in line with the African Union's aspirations set in Agenda 2063 to build an Africa whose development is people driven, relying on the potential offered by people, especially its women and youth and caring for children.<sup>134</sup>

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<sup>133</sup> Austin Clark, "[Government 'must play central role in AI development'](#)", GovTech Leaders, 16 April 2018.

<sup>134</sup> The [Agenda 2063](#) is a strategic framework for the socio-economic transformation of the continent over the next 50 years. Its builds on, and seeks to accelerate the implementation of past and existing continental initiatives for growth and sustainable development.

## CONCLUSIONS

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Artificial intelligence is an important opportunity for the continent of Africa. If governments can successfully navigate the challenges, AI can be a driver of growth, development, and democratisation. It has the potential to enhance productivity growth by expanding opportunities in key sectors for Africa's development, including agriculture, healthcare, financial services, and government services. By empowering workers, entrepreneurs, and businesses with access to high-quality digital tools, they are able to compete at a global level and be at the forefront of economic transformation.

However, the obstacles in the way require serious policy responses. AI will mean substantial adjustments for workers and business and opens new ethical questions that require thoughtful responses. Specific to Africa, labour and ethical questions are compounded by higher hurdles stemming from connectivity, the readiness of education systems, and the availability of digital data. Africa needs to take decisive steps to overcome its unique challenges, but if it can, it has the opportunity to catch up to those countries that have already taken steps to advance AI.

These efforts will not be easy, but the path forward is clear. Success will depend on the ability of governments to foster collaboration among all stakeholders — state and civil society, academia, industry, and national and international stakeholders. If these groups jointly embrace the challenges of AI, Africa will reap the benefits of a vibrant AI ecosystem.

## ANNEXE: INTERNATIONAL AI STRATEGY APPROACHES

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Countries around the world are positioning themselves to lead the AI revolution. Through policy interventions and targeted investments calibrated to each country's specific needs and strengths, they are working to ensure they are at the forefront of development and adoption of AI tools.

Although it is unclear how much countries are allocating to AI initiatives in the public and private sector as a whole, AI investment is occurring across much of the world. In China, the government of Beijing has committed USD 2 billion to build an AI development park in the city; the nearby city of Tianjin has promised to invest USD 5 billion in an AI fund.<sup>135</sup> South Korea and Canada have committed close to USD 1 billion to push forward AI initiatives,<sup>136</sup> while the UAE has invested significant resources in AI development policy; in 2017 the government created the first Minister of State for AI, focusing on specifically on AI initiatives.<sup>137</sup>

### Canada

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As a leading technology hub, Canada has pioneered research in AI and has the world's third largest AI talent pool.<sup>138</sup> In the past five years, the private sector's interest in AI has accelerated and transitioned a solid academic AI foundation into a thriving commercial AI ecosystem. Canadian companies are implementing AI technology in fields as diverse as fintech, business analytics, life sciences, and autonomous vehicles. This has brought cutting-edge advances and intelligent solutions to some of society's most pressing problems. The government is leveraging this strong ecosystem to take a leadership role on ethical issues in AI.

#### Strategic and Light-Touch Leadership

There is no comprehensive regulatory approach to AI and its development in Canada, but that does not mean the government has been sitting still. One of Canada's primary strengths is its strong business environment that enables innovation and its openness to entrepreneurs, individuals, technologies, and investments from outside of its borders. Canada has attracted talent, companies, and foreign investment across a range of AI verticals. Multinational companies are expanding their research facilities in Canada because they see great opportunities in the market and a deep existing pool of talent. For instance, DeepMind, Google's AI research division, opened its first international AI research office in Edmonton, Alberta in July 2017.<sup>139</sup> Other AI-driven global companies have also established a presence in Canada including Facebook, Samsung, General Motors, IBM, Microsoft, Thomson Reuters, Thales, and Uber.<sup>140</sup> Microsoft, which first developed its Canadian AI presence by acquiring deep learning startup Maluuba in 2016, recently doubled its research centre in Montreal and appointed AI expert Geoffrey Gordon from Carnegie Mellon University its Director.<sup>141</sup>

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<sup>135</sup> Vikram Barhat, "[China is determined to steal A.I. crown from US](#)", CNBC, 4 May 2018.

<sup>136</sup> Cade Metz, "[As China Marches Forward on AI, the White House is Silent](#)", *The New York Times*, February 12 2018.

<sup>137</sup> For more information on UAE Strategy for Artificial Intelligence, see [UAE government website](#).

<sup>138</sup> Danielle Goldfarb and Candice Faktor, "[Four ways Canada can own the AI century](#)", *Macleans*, February 22 2018.

<sup>139</sup> For more information on DeepMind, see [company website](#).

<sup>140</sup> The Government of Canada, "[Canada: A Pioneer in AI Innovation](#)", AI Business, April 27 2018.

<sup>141</sup> For more information on Microsoft Montreal research lab, see [Microsoft website](#).

Building on these resources and depth of academic resources, strategic interventions from the government have been designed to focus research and development and take steps to better understand legal and social implications. Since 2017, the Government of Canada announced three important government initiatives to advance AI:

- The Pan-Canadian Artificial Intelligence Strategy, a CAD 125-million plan to attract and retain leading AI researchers and strengthen the country’s AI centres of excellence in Edmonton, Montreal, and Toronto.<sup>142</sup>
- The CAD 950 million Innovation Supercluster Initiative which provides funding for innovative companies that commercialise solutions based on Canada’s leadership in the field of AI.<sup>143</sup>
- The Global Skills Strategy, a fast-track immigration programme designed to bring high-tech talent to Canada.<sup>144</sup>

These private and public investments resulted in the launch of several new institutes and research and development labs throughout Canada. One widely-recognised facility, the Vector Institute, was launched in Toronto in March 2017, as a partnership between the federal and provincial governments, the University of Toronto, and over thirty corporate sponsors including Google, Nvidia, Uber, and Canadian technology leaders Shopify and Thomson Reuters.<sup>145</sup>

### **Ethical AI Leadership**

While much of the focus over the past five years has been on innovative research and the commercialisation of AI technologies, Canada is also striving for leadership in ethical approaches to AI. One of the Canadian Government’s Pan-Canadian Artificial Intelligence Strategy’s main goals is to develop “global thought leadership on the economic, ethical, policy, and legal implications of advances in artificial intelligence”.<sup>146</sup> Learning from stakeholders is an indispensable element of this.

To that end, the federal government concluded its first public consultations on the responsible use of AI in government in early 2018. Global Affairs Canada and the Canadian Institute for Advanced Research (CIFAR) led a multi-university collaboration on AI and human rights, and the Canadian CIO Strategy Council began working on national ethical AI standards in April 2018.<sup>147</sup> The Treasury Board Secretariat (TBS) of Canada is also now finalising the first round of public consultations to explore responsible use of AI in government.<sup>148</sup>

In 2018, Canada held the presidency of the G7, using it as an opportunity to highlight the role of governments in the responsible development of AI, including fulfilling human rights obligations and ensuring trust and inclusivity in AI applications. Ahead of the recent G7 summit, Prime Minister Justin

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<sup>142</sup> For more information on Pan-Canadian AI Strategy, see [CIFAR website](#).

<sup>143</sup> For more information on Canada’s Innovation Superclusters Initiative, see [Government of Canada website](#).

<sup>144</sup> For more information on Canada’s Global Skills Strategy, see [Government of Canada website](#).

<sup>145</sup> At the announcement of its recent expansion, Dr. Hinton stated that the world’s most promising researchers in deep learning and other AI subfields are looking at Canada as a hub with many opportunities to collaborate, advance research and develop applications.

<sup>146</sup> For more information on Pan-Canadian AI Strategy, see [CIFAR website](#).

<sup>147</sup> For more information on the Canadian CIO Strategy Council, see [Cision website](#).

<sup>148</sup> “[Here’s How Canada can be a global leader in ethical AI](#)”, *The Conversation*.

Trudeau committed to engaging experts across a diverse cross section of society to better understand how to develop AI in a way that may benefit everyone.<sup>149</sup> The G7 countries agreed to a common vision for the development of AI in June,<sup>150</sup> where they “must ensure that the nascent AI industry brings to our societies and our economies the most significant benefits possible in the coming years, while safeguarding privacy rights.”<sup>151</sup>

## China

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China has ambitious plans to be the world’s AI leader by 2030. In contrast to Canada’s light touch approach, China has opted for centralised direction and a massive commitment of resources. Not only is China investing heavily in AI — its experts aim to set the rules of the game on global standards for the technology.

China has a comprehensive AI plan endorsed by the highest level of government, with specific and ambitious quantified targets for AI development. The plan involves over 15 government agencies and utilises extensive public-private partnerships.<sup>152</sup> In the near term, a three-year action plan has been created to guide AI development.<sup>153</sup> In addition to development goals, it acts as “a policy guide” to promote the collaboration between leading enterprises, upstream and downstream small enterprises, and research institutions.<sup>154</sup> As part of the plan, the National Development and Reform Commission (NDRC) — a national economic planning centre — announced an AI Innovation and Development megaproject that emphasises service robots, deep-learning AI chips, and unmanned systems.<sup>155</sup>

Serious efforts are also being made to develop policy around AI’s development and implications. The Chinese government’s strategic plan for AI suggests that China intends to play a role in setting technical standards for AI going forward — including to establish Chinese standards at the global level.<sup>156</sup>

### **Promoting Early Adoption Across Verticals**

The Chinese government has made AI initiatives in education a cornerstone of its national strategy. Academics and policy makers are increasingly looking to AI to reform China’s education and public research, as well as modernise classrooms. According to market research firm IT Juzi, education and

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<sup>149</sup> [“Canada and France make historic commitment to inclusive and ethical AI.”](#) CIFAR.

<sup>150</sup> The Group of Seven (G7) is a group consisting of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. These countries, with the seven largest advanced economies in the world, represent more than 62 percent of the global net wealth (USD 280 trillion).

<sup>151</sup> [“G7 Nations Agree on ‘Common Vision’ for AI”](#). Firenewsfeed.

<sup>152</sup> The plan is led by the Ministry of Science and Technology (MOST) and the Science and Technology Bureaucracy (S&T). This is a whole government endeavor involving 15 different entities, with Most, NDRC, and the Ministry of Industry and Information Technology (MIIT) taking the lead. In addition, the official involvement of the Central Military-Civil Fusion Development Commission Office, the Central Military Commission (CMC) Science and Technology Commission, and the CMC Equipment Development Department confirms the inclusion of a focus on [military applications](#) of AI within this broader national agenda. For more info

<sup>153</sup> For more information on China’s AI Three-Year Plan on AI, see [Technology Review website](#).

<sup>154</sup> Paul Triolo, Elsa Kania, Graham Webster, [“Chinese government outlines AI ambitions through 2020.”](#) NewsAmerica, 26 January 2018.

<sup>155</sup> The Diplomat. Elsa Kania, [“China’s AI Agenda Advances.”](#) *The Diplomat*, 14 February 2018.

<sup>156</sup> Will Knight, [“China wants to shape the global future of AI”](#), *MIT Review*, March 16 2018.

academic research rank third behind medicine and automobiles among industries that paved the way for unprecedented change thanks to AI.<sup>157</sup> One company is Huijiang, which has a leading online presence in education.<sup>158</sup> The company leverages AI techniques in the classroom by embedding image and voice recognition tools in the classroom. This is designed to track attendance, refine teaching methods, and maximise student engagement.<sup>159</sup>

China is also promoting uses of AI within the healthcare sector. Chinese tech giant Alibaba has created AI software that can interpret CT scans and an AI medical lab to assist in making diagnoses.<sup>160</sup> Tencent developed Miying, a medical imaging programme that detects early signs of cancer. It is now used in almost 100 hospitals across the country, improving the accuracy of diagnoses and the quality of healthcare outcomes for Chinese patients.<sup>161</sup> The oil and gas industry is also at the forefront of AI adoption. China Petroleum and Chemical Corporation (Sinopec) has indicated its intention to leverage AI technology, including 10 “intelligent plants” with a goal of a 20 percent reduction in operating costs within their long-term corporate plans.<sup>162</sup>

## India

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India has a traditionally strong and globally engaged ICT sector. The government sees the transformative impact these technologies will have and has taken early steps to position India to exploit these for the good of its citizens. To reach this goal, India is focusing on a few priority sectors and ensuring that India partners with global leaders.

### Finding Comparative Strengths

Rather than rush into policy-making, the government has recently assumed a role to help convene stakeholders to formulate national priorities and increased its commitment to fund research. The Ministry of Commerce and Industry has developed an AI Taskforce which released a report in March 2018 that outlined AI challenges to India, what enables commercialisation, and the need for increased investment in AI research and focused academic curricula.<sup>163</sup> To this end, the national 2018 budget doubled the investment in the Digital India programme (USD 477 million) to fund advances in AI.

Additionally, in early June 2018, the National Institution for Transforming India (NITI Aayog) released a white paper to support the development of a comprehensive national AI strategy.<sup>164</sup> NITI Aayog identified five areas with the greatest potential to develop high-impact applications and leverage the greatest benefits:<sup>165</sup>

- **Healthcare** — increase access to affordability of quality healthcare.

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<sup>157</sup> Alexis Chemblette, “[How China is Trying to Become the World’s Leader in AI](#)”, *Adweek*, May 8 2018.

<sup>158</sup> Meng Jing, “[China wants to bring AI to its classrooms to boost its education system](#)”, *SCMP*, 14 October 2017.

<sup>159</sup> Rich Haridy, “[AI in schools: China’s massive and unprecedented education experiment](#)”, *Newsatlas*, May 28 2018.

<sup>160</sup> Sui-Lee Wee and Paul Mozur, “[Amazon Wants to Disrupt Health Care in America. In China, Tech Giants Already Have.](#)” *The New York Times*, 31 January 2018.

<sup>161</sup> *Ibid.*

<sup>162</sup> Kumba Sennaar, “[Artificial Intelligence in Oil and Gas—Comparing the applications of 5 Oil Giants](#),” *Tech Emergence*, 22 August 2017.

<sup>163</sup> [Report of the Artificial intelligence Taskforce](#),

<sup>164</sup> [National Strategy for Artificial Intelligence](#), June 2018.

<sup>165</sup> *Ibid.*



- **Agriculture** — enhanced farmers' income, increase farm productivity, and reduce waste.
- **Education** — improve access and quality of education.
- **Smart Cities and Infrastructure** — improved efficiency and connectivity to manage burgeoning urban populations.
- **Smart Mobility and Transportation** — smarter and safer modes of transportation to reduce traffic congestion.

### **Strategic Partnerships**

AI initiatives in India have also attracted strong interest from non-Indian companies. According to the Brookings Institute, 70 percent of the AI research in the country occurs in non-Indian firms.<sup>166</sup> The Government of India has led the way through a number of private sector partnerships. For example, NITI Aayog is working with Microsoft and Forus Health to pilot a technology for early detection of diabetic retinopathy, a very important issue as India is faced with a diabetes epidemic. Just last year, 72 million people in India were registered as having diabetes.<sup>167</sup> Additionally, 3Nethra, developed by Forus Health, is a portable device that can screen for common eye diseases and disorders.<sup>168</sup> Integrating AI capabilities to this device using Microsoft's retinal imaging APIs enables operators of 3Nethra device to get AI-powered insights in remote areas with limited connectivity to the cloud. The AI technology solution resolves past quality issues in images and provides accurate results.

Another important sector to India is the agriculture industry. The agriculture industry in India accounts for 7.68 percent of total GDP, much higher than the world average of 6.1 percent.<sup>169</sup> NITI Aayog and IBM have partnered to develop a crop yield prediction model leveraging AI tools to provide real time information to farmers.<sup>170</sup> IBM's AI model provides predictive analysis to improve crop productivity, soil yield, control agricultural inputs and early warning on pest/disease outbreak by processing data from remote sensors connected via satellite, soil health cards, India Meteorological Department's (IMD) weather predictions and soil moisture/temperature, crop phenology etc. This improves the accuracy and depth of information available to farmers, so they can better optimise their resources and tend to their crops more strategically. The project is being scaled and replicated to ten Districts across the States of Assam, Bihar, Jharkhand, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

The Andhra Pradesh state government is utilising data to drive decisions on how to deliver education and are currently working to reduce the dropout rate in schools, in partnership with Microsoft. Based on input factors, such as gender, socio-economic demographics, academic performance, school infrastructure, and teacher skills, an application powered by Azure Machine Learning can find predictive patterns. With these insights, the district education officials can predict the likelihood of the student's dropout rate and offer counselling sessions to the students and their parents. The Andhra Pradesh government, based on machine learning and analytics, has identified about 19,500

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<sup>166</sup> Shamika Ravi and Darrell M. West, "[Artificial Intelligence and Data Analytics in India](#)" *Brookings*, 17 May 2018.

<sup>167</sup> For more information on IDF SEA Region, see [IDF website](#).

<sup>168</sup> [National Strategy for Artificial Intelligence](#), June 2018.

<sup>169</sup> "[Sector-wise contribution of GDP of India](#)", *Statistics Times*, 21 March 2017.

<sup>170</sup> [National Strategy for Artificial Intelligence](#), June 2018.

probable dropouts from government schools in Visakhapatnam district for the next academic year (2018-2019).<sup>171</sup>

## Mexico

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To promote the growth and adoption of AI, Mexico has partnered with key players to use public services to demonstrate proof of concept and bring value to its citizens. Its experience shows how AI can not only democratise access to economic potential, but also empower citizens to relation to public services and participation.

The government developed and launched a National Artificial Intelligence Strategy in March 2018,<sup>172</sup> making it the first Latin American country to do so.<sup>173</sup> The strategy calls for the following:

- developing an AI subcommittee within the Intergovernmental Commission for Electronic Governance, to promote multi-sectoral dialogue and approaches;
- mapping use cases and needs of industry, and identifying best practices within government;
- promoting Mexico's international leadership in digital policy, with a special emphasis on the OECD and D7; and
- working with experts and citizens through the AI subcommittee to refine approaches and ensure the continuity of these efforts with future governments.

### **Enhancing Public Services**

The public and private sectors have worked together in Mexico to leverage AI applications to enhance public services and make them more responsive. In Mexico City, Laboratorio para la Ciudad and SM1 are collaborating in a project with Red Ninja, a United Kingdom startup, to optimise transportation flows. The team is analysing data from GPS detection within SM1 buses to create a more efficient system for bus departures. If the tool is successful, the team will seek to replicate this for all routes in the city.<sup>174</sup> Ultimately, this would alleviate congestion, improve efficiency, and increase frequency of buses transporting passengers.

The city of Guadalupe and Tlanepantla de Baz (State of Mexico) has rolled out the One Smart City project to enable more responsive government. The project creates and curates software for governments to become more innovative, efficient, and transparent via the use of AI. In 2016, One Smart City piloted their SmartUNO software in these cities to generate algorithms to make better sense of discourse in social networks and generate actionable outcomes for governments.<sup>175</sup>

Similarly, URBEM, developed by Civica Digital, is a tool that uses an AI-enabled chatbot in Facebook Messenger to answer citizens' requests for information, provide documents, and gather feedback. It also provides a means of centralising data and combines this with an internal administrative

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<sup>171</sup> [National Strategy for Artificial Intelligence](#), June 2018.

<sup>172</sup> For more information on Mexico's AI Strategy, see [government website](#).

<sup>173</sup> Emma Martinho-Trustwell and Constanza Gomez Mont, "[Mexico leads Latin America as one of the first ten countries in the world to launch AI strategy](#)", *Oxford Insights*, 24 May 2018.

<sup>174</sup> For more information on the SmartCity project, see [Cminds website](#).

<sup>175</sup> For more information on the SmartUNO software, see [Cminds website](#).

dashboard. The Facebook chatbot provides all Civil Registry-related information to around 200 daily users with an 82 percent rate of service satisfaction. This has freed staff from routine requests and allowed them to focus on more complicated cases.<sup>176</sup> Municipalities of San Pedro Garza Garcia, Nuevo Leon, and Hermosillo, Sonora have adopted successful elements of the programme to provide a single portal for citizens access to information about the status of local utilities and to report any problems.<sup>177</sup>

## United Kingdom

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Similar to Canada, the UK has focused on facilitating and investing, rather than regulating, and worked to build on the strength of the UK's economy and human resources through key partnerships with its academic, tech, and finance ecosystems. An openness to sharing data between the private sector as well as focus on attracting global talent makes the one of the most competitive countries for AI.

Instead of framing a "strategy," the United Kingdom has offered a "deal" to promote the sector.<sup>178</sup> Growing out of the recommendations of the October 2017 report "Growing the Artificial Intelligence Industry in the UK," the UK Artificial Intelligence Sector Deal is a pack of measures and over GBP 1 billion in new investments by both the public and private sectors. Along with promotion through a new expert AI Council and an Office for Artificial Intelligence, the government commits to increase R&D expenditure on selected areas, create new fellowship programs and doctoral slots, facilitate immigration of AI-experts, and improve broadband networks.

Another key area the deal features heavily is data sharing. The deal commits to expand the public data infrastructure, and develop a framework for fair, equitable, and secure data sharing and a public-private dialogue to identify barriers to sharing data. It also calls to explore the concept of Data Trusts, which are platforms for data to be shared between AI companies.<sup>179</sup> This novel concept will make data more accessible to developers.

### Collaborating to Push AI Forward

In March of 2017, the government called for an industry-led review of AI. As part of an "Industrial Strategy" whitepaper, the government announced its intention to put the UK at the centre of the AI revolution.<sup>180</sup> The "Industry Strategy Challenge Fund" is a USD 5.4-billion investment to encourage innovative R&D.<sup>181</sup> The whitepaper highlights DigitalGenius, a company that has developed a customer service platform that utilises human and machine intelligence to automate customer support.<sup>182</sup> The UK is also building a USD 12 million "data ethics and innovation centre" to deal with ethical issues related to AI such as the quality of input data to AI processes.<sup>183</sup>

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<sup>176</sup> For more information on the chatbot, see [Cminds website](#).

<sup>177</sup> For more information on public use of AI, see [Cminds website](#).

<sup>178</sup> "Artificial Intelligence Sector Deal", HM Government, April 2018.

<sup>179</sup> Professor Dame Wendy Hall and Jerome Pessenti, "Growing the Artificial Intelligence Industry in the UK."

<sup>180</sup> "Industrial Strategy Building a Britain fit for the future", HM Government, November 2017.

<sup>181</sup> "Industrial Strategy Building a Britain fit for the future", HM Government, November 2017.

<sup>182</sup> "Industrial Strategy Building a Britain fit for the future", HM Government, November 2017.

<sup>183</sup> Jonathon Vanian, "United Kingdom Plans \$1.3 billion Artificial Intelligence Push", *Fortune*, 25 April 2018.

Public-private partnerships in the UK have demonstrated how collaboration is key to advancement. Within the healthcare sector, partnerships have been formed between the National Health Service (NHS) and AI developers like IBM, DeepMind, and Babylon Health.<sup>184</sup> Within the finance sector, the UK-based hedge fund Man Group uses AI algorithms for investment strategy. The algorithm scours millions of data points to recognise patterns that humans can't see.<sup>185</sup> One bank, HSBC, is leveraging AI and machine learning to identify money-laundering cases. Machine learning and AI technologies can spot irregularities in financial data and predict cases in which regular transactions do not fit the "mould".<sup>186</sup> Lastly, within the education realm, the Behavioural Insights Team (BIT) government office is utilising machine learning to evaluate outcomes of schools, health care, and social care programs.<sup>187</sup>

## United Arab Emirates

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The UAE has moved decisively to position itself at the forefront of AI developments. The UAE has committed to a vision to develop itself as one of the leaders for AI in the region and the world and demonstrated a strong commitment at the highest levels towards AI development in the country. The government is pushing forward efforts through investing in education and skill development to allow people to adapt to the change. Similarly, legal institutions are analysing the risks associated with AI technology. Prioritising AI initiatives in the highest levels of government in the UAE provides a strong foundation for AI-led growth within the region.

### Commitment at the Highest Levels

The leadership of the UAE sees AI as an indispensable tool to drive growth and economic development. The annual growth in the contribution of AI is expected to range between 20-34 percent per year across the Middle East region, with the fastest growth in the UAE. The government's 2015 Science, Technology, and Innovation Policy projects that AI in the UAE will contribute USD 96.0 billion by 2030 up to 13.6 percent of GDP,<sup>188</sup> and details significant spending in STEM education.<sup>189</sup>

To attain their goals, the United Arab Emirates released an AI strategy in October of 2017.<sup>190</sup> Among a variety of objectives, the strategy focused on "launch[ing] leadership strategy and issue[ing] a government law on the safe use of AI".<sup>191</sup> It also created a Ministry of Artificial Intelligence, the first in the world, to implement and pursue AI projects.<sup>192</sup>

Within the UAE, Dubai is leading the way for AI. The Emirate has implemented the Smart Dubai strategy, which aims to transform the city through innovation and digital transformation. The government launched an AI smart lab in 2017 focused on training public and private sector employees

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<sup>184</sup> ["Artificial Intelligence in healthcare and research."](#) Nuffield Council on Bioethics.

<sup>185</sup> Scott Carey, ["How UK Banks are looking to use AI and machine learning"](#), *Computer World UK*, 10 April 2017.

<sup>186</sup> Scott Carey, ["How UK Banks are looking to use AI and machine learning"](#), *Computer World UK*, 10 April 2017.

<sup>187</sup> Matt Reynolds, ["UK's Nudge Unit tests machine learning to rate schools and GPs,"](#) *Wired*, 14 December 2017.

<sup>188</sup> ["The potential impact of AI in the Middle East"](#), PWC.

<sup>189</sup> [Science, Technology, and Innovation Policy in the UAE](#), UAE Government 2015.

<sup>190</sup> For more information on UAE AI strategy, see [government website](#).

<sup>191</sup> ["UAE Strategy for Artificial Intelligence."](#)

<sup>192</sup> Malik Al Ash-Shaykh, ["The UAE just appointment a minister for AI"](#), *Step Feed*, 19 October 2017

in implementing AI in their fields.<sup>193</sup> In the transportation vertical, they have also implemented the Dubai Autonomous Transportation Strategy, which aims to cut transportation costs by 44 percent, carbon emissions by 12 percent and accidents by 12 percent by transforming 25 percent of all transportation in the city to autonomous modes by 2030.<sup>194</sup>

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Sherouk Zakaria, [“Smart lab accelerates AI move”](#), *Khaleej Times*, 27 March 2017.  
For more information on UAE future 2030-2021, see [government website](#).