

Google

AI in Nigeria

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Introduction

Artificial Intelligence (AI¹) is powerful and has the potential to deliver many benefits to the Nigerian economy. As such, the government needs to play an important role in partnering with industry and the community to ensure its deployment is safe, fair, and produces positive outcomes. Given the early stage of AI development in Nigeria, we believe it's important to make sure that policy makers have a clear and consistent understanding of the current state of AI in Nigeria-- the state of current laws and regulations as it applies to AI, current applications of AI, and the challenges AI presents on a policy level. We also present areas where the government, in collaboration with wider civil society and AI practitioners, can play a crucial role in advancing AI in Nigeria. We hope this paper can help in evolving the discussion to address policy ideas and implementation of AI in Nigeria.

¹ AI is a broad term with no consensus definition. In this paper, we use the AI definition provided by Nils J. Nilsson: "Artificial Intelligence is the activity devoted to making machines intelligent, and intelligence is the quality that enables an entity to function appropriately and with foresight in its environment."

Present state of AI in Nigeria

AI as a tool to advance the Nigerian economy

Nigeria is Africa's largest economy, and 28th globally. As of 2017, Nigeria had a GDP of \$400.6 billion, making it about 0.5% of the world's GDP. It is estimated that Nigeria will have the largest population in the world in 2100². As the population grows, small and medium sized businesses have increased their presence by using tools such as WhatsApp to advertise their products and complete transactions. With a high addressable population, Lagos has been labelled Africa's most valuable startup ecosystem, with start-ups typically raising more money compared to other African countries³.

With the growing population and interest in the local startup ecosystem, the government has seen the potential to solve the country's challenges, mobilize local investment and attract more foreign investment into the country through the investment, application, and use of AI. For example, the Minister of Science and Technology, Dr. Onu (2017), shared that the goal⁴ for the Technology and Innovation Roadmap is:

- For Nigeria to not rely on foreign expertise for its needs but use and produce what is used locally. Ensuring that Nigeria is well suited to drive the AI economy forward is critical to driving knowledge and innovation.
- To create jobs through the processing of commodities. By not exporting, Nigeria is optimistic that they can create more opportunities for Nigerians.

Given the perceived value in investing in the digital economy in Nigeria, the government must play a critical role in creating a conducive environment for creating and adopting new technologies, including AI.

Current applications of AI

AI products are being built across a number of domains in Nigeria. However, the government or larger corporations are not predominantly shaping the space. Most solutions are created and/or owned by individuals and groups in the private sector. Some of these activities are driven by the Office of the Vice President in collaboration with consultants who form part of a delivery unit that advise on an increasing range of tech based or focused initiatives:

- **Fintech:** Most of the traction is in the fintech (financial technology) sector as strict financial regulations have enforced financial institutions to collect copious amounts of data over the years, which makes it relatively easier to have access to datasets. In addition, applications of fintech range from credit scoring apps to fraud detection to chatbots for

² Hoorweng, D., & Pope, K. (2014). Socioeconomic Pathways and Regional Distribution of the World's 101 Largest Cities, Global Cities Institute Working Paper No. 04.

³ Startup Genome (2017). Global Startup Ecosystem Report, 2017, from <http://d1i53wesras4r4.cloudfront.net/reports/GlobalStartupEcosystemReport2017.pdf>

⁴ Dr. Ogbonnaya Onu (2017). Minister Of Science On Technology Road Map, from <http://nigeria.watsupafrica.com/news/minister-of-science-on-technology-road-map/>

banks to use as a customer service touchpoint. Ada and Leo⁵ are examples of those. However, one key issue is that this data collection has occurred in a regulatory environment lacking an overarching data protection law. This means that data may have been collected, utilised and or protected without explicit knowledgeable consent from people, creating concerns surrounding user privacy and data security.

- **Safety:** In addition to fintech, other application areas the government foresees for AI in the long term (as defined in the Science, Technology and Innovation Roadmap⁶) are all related to security and safety:
 - Robots for hazardous (e.g. bomb detonation, excavation of toxic materials and rescuing people) and repetitive tasks (*expected to be implemented in 2021*)
 - Portable, intelligent and scenario-reporting robots for military and disaster management applications (*expected to be implemented in 2022*)
- **Traffic Regulation:** The Lagos State Government is using AI to enforce traffic regulations with the use of ANPR⁷ cameras to scan license plates and fine motorists who violate traffic laws. The vehicle inspection service has revealed that about 13,750 motorists have been identified via this system in the first quarter of 2019. The data collected is also useful for criminal investigations which involve tracking the movement of certain vehicles.
- **Agriculture:** In the near future, the government wants to solve sector specific issues using technology - especially in agriculture. Nigeria has a young and growing economy. This increase in population size implies a higher pressure on already limited resources. 70% of the population in Nigeria engages in agricultural production. Thus, it remains the case that agriculture is critical to the Nigerian economy and to Nigeria's future success⁸.
- **Health:** Access Partnership⁹, a public policy firm which monitors and analyses global trends for the risks and opportunities they create for technology businesses and identifies strategies to mitigate those risks and drive opportunities, has argued that AI can unblock gaps in healthcare by empowering and supplementing staff, improving public health policy, improving healthcare delivery, providing better diagnostics and detection and improving access to healthcare.
- **Digital Identity:** Recently, Nigeria was granted \$433 million dollars to extend its digital identity program¹⁰ to 100 million people over the next 3 years by leveraging biometric authentication. These identification systems work to improve government provisions and decrease fraud.

AI laws and regulation

There are several laws and regulations that are shaping the way AI is developed and implemented. Some examples include:

⁵ ADA Meets Leo: 2 Nigerian Banks Introduces Social Media Chatbots, from <https://techcrub.com/nigerian-banks-social-media-chatbots/>

⁶ National Science, Technology, and Innovation Roadmap (NSTIR) 2030, June, 2017

⁷ Automatic Number Plate Recognition (ANPR), from https://en.wikipedia.org/wiki/Automatic_number_plate_recognition

⁸ Nigeria's minister for agriculture: Adesina says "Agriculture is the future of Nigeria. And agriculture that is modernised, that is productive, that is competitive. We must be a global player," he says.

⁹ Access partnership, from <https://www.accesspartnership.com/>; White paper, from https://www.up.ac.za/media/shared/7/ZP_Files/ai-for-africa.zp165664.pdf

¹⁰ Biometric Update, "High Traffic Identification tops this week's biometric update," from <https://www.biometricupdate.com/201909/progress-in-nigeria-and-high-traffic-identification-top-this-weeks-biometrics-and-digital-id-news>

Data Protection Regulation¹¹

- The National Information Technology Development Agency (NITDA) was set up by the National Information Technology Development Agency Act 2007 (NITDA Act) as the statutory agency with the responsibility for planning, developing and promoting the use of information technology in Nigeria. The NITDA Act “empowers the Agency to develop guidelines for electronic governance and monitor the use of data exchange and other forms of electronic communication transactions as an alternative to paper-based methods of government.”
 - NITDA Data Regulation: The Data Protection Regulation was launched at the beginning of 2019. Prior to this, there were snippets of regulation in the constitution and other legal legislations. Both Laws identify a special category of personal data which the Regulation termed sensitive personal data. The special categories of data as stated in the GDPR are those which “reveal racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a person's sex life or sexual orientation. The regulation is similar to the EU GDPR in many ways and applies to all transactions in which the personal data of natural persons resident in Nigeria, or natural persons outside Nigeria of Nigerian descent, is being processed.” There are some differences, however:
 - The GDPR permits the processing of sensitive information where it is publicly available. This is not recognized by the Nigerian Data Protection Regulation (NDPR).
 - The GDPR excludes the processing of personal data in the course of a purely personal or household activity. This is not the case in the NDPR.
 - Companies were given a period of 2 years to ensure compliance when the GDPR was adopted in 2016. The Data Protection Regulation of Nigeria however, is effective from the date it was issued (28th January, 2019) by NITDA.

Other bills, policies, and institutions

Other policies, bills and institutions exist to regulate and potentially fund activities in research in the areas of Science and Technology:

- **Nigeria Data Protection (2019)¹²**: Preserves the right to privacy of natural persons resident in Nigeria, or natural persons outside Nigeria of Nigerian descent.
- **Data Interoperability Standards (2016)¹³**: Provides standards to improve data sharing between data-sharing communities without requiring complex mediations.
- **The National Health Research Ethics Committee¹⁴**: Ensures the protection of human participants in scientific research to the highest ethical standard that is possible.
- **The National Research and Innovation Council¹⁵**: Sets national priorities on research, innovation and development.

¹¹ Davidon Oтуру, “An Overview of Big Data and Data Protection in Nigeria.” April, 2019 from, <http://www.mondaq.com/Nigeria/x/799404/Data+Protection+Privacy/An+Overview+Of+Big+Data+And+Data+Protection+In+Nigeria>

¹² Nigeria Data Protection Regulation 2019, <https://nitda.gov.ng/wp-content/uploads/2019/01/NigeriaDataProtectionRegulation.pdf>

¹³ Data Interoperability Standards, 2016, <https://nitda.gov.ng/wp-content/uploads/2018/07/DATA-INTEROPERABILITY-STANDARDS.pdf>

¹⁴ National Code of Health Research Ethics, 2017, from <http://nhrec.net/download-nchre/>

¹⁵ Ifeanyi Ndiomewese, “Nigeria has a National Research and Innovation Council that Oversees matters of innovation in the country.” April, 2019, from <https://techpoint.africa/2019/04/05/national-research-and-innovation-council/>

Access to data

Apart from the government's interest in national applications of AI and efforts to regulate the space, it is making data accessible to developers through APIs and reports. These reports and APIs are available for developers and researchers who need data on identity verification and other financial indicators.

- **National Identity Management Commission**¹⁶ - enables verification of identities of persons enrolled in the National Identity Database through a SOAP based web service which can be integrated into client applications.
- **The Nigerian stock exchange**¹⁷ - provides trade information and security statistics through the NSE Application Programming Interface (API), Financial Information exchange (FIX) protocol, Nigerian Stock Exchange Network (X-Net), Direct Market Access (DMA) and downloads from the site.
- **Nigerian inter-bank settlement system (NIBSS)**¹⁸ - provides live data on POS and national interbank payments, and periodic payment summaries in the form of PDFs.
- **National Bureau of Statistics**¹⁹ - provides infographics, PDF reports and spreadsheets of various economic indicators (e.g., imports and exports, food, transport, gas prices, etc).

The rise of fintech firms in Nigeria is reported²⁰ to have compelled the Central Bank of Nigeria [CBN] to make these systems available.

Top Potential Risks of AI in Nigeria

While the above applications seek to address disparities in development, the positive ways AI can augment skills and address deficits in resources can also be harnessed by bad actors²¹ that are looking to contain political opposition and inflict harm on others; or misused. For example, there is a fear that advances in technology will increase the potential for cyber attacks, especially with the history of cybercrime²² associated with Nigeria. To combat the prevalence of cybercrime, cybersecurity is now an issue of national priority²³ and the government recently took action by launching a toolkit²⁴ to educate small businesses on how to protect themselves and their customers online. While AI may exacerbate cybercrime, it can also serve to be beneficial if it improves how security experts analyze, study, and understand cybercrime. Thus, the government should continue to look into ways AI can be used as a prevention and resolution to cyber attacks.

¹⁶ National Identity Management System, from <https://www.nimc.gov.ng/>

¹⁷ Nigerian stock exchange, from <http://www.nse.com.ng/>

¹⁸ Nigerian Inter-bank Settlement System (NIBSS), from <https://nibss-plc.com.ng/>

¹⁹ National Bureau of Statistics, from <https://nibss-plc.com.ng/>

²⁰ CBS, NIBBS Open up Payment and Settlement Systems to FinTech Firms, from <https://www.financialtechnologyafrica.com/2017/05/10/cbn-nibss-open-up-payment-settlement-systems-to-fintech-firms/>

²¹ These are examples of potential risks of AI, but they are not comprehensive. Risks can extend far beyond those that involve bad actors. As AI gains popularity in Nigeria, it is important to understand the ways in which it could potentially cause harm.

²² The estimated annual cost of cybercrime to Nigeria is approximately \$350 million

²³ The President of Cyber Security Experts Association of Nigeria: Remi Afo says, "Rapid technological advances in cloud adoption, blockchain implementation, artificial intelligence and data science, has increased the potential for cyber-attacks and data breaches in today's digital landscape."

²⁴ GCA Cyber Security Toolkit, from <https://qcatookit.org/smallbusiness/>

In addition to cyber attacks, deep fakes²⁵, or the creation of artificial videos, voice recordings, and other media, could be used to emphasize existing ethnic and religious divisions and to attack nascent democratic institutions. For example, one scenario that could cause harm is if a supporter of an extremist group fabricated inflammatory audio recordings in an effort to exacerbate religious division. However, at the time of this report's publication, this scenario in Nigeria is hypothetical and should not distract from more prevalent ways people can falsify videos and images through fake images or shallow fakes²⁶.

Furthermore, the growth of AI surveillance tools to monitor, track, and surveil citizens to accomplish a range of policy objectives is spreading at a faster rate globally. Although less than one-quarter of Sub-Saharan African countries have invested in AI surveillance, increases in internet penetration and broadband access will likely cause these numbers to rise in the upcoming years²⁷. For example, Huawei is a large Chinese telecommunications company that is responsible for up to 70% of Africa's telecommunications network. The Ugandan police force recently confirmed that the company was installing \$126 million facial recognition infrastructure across the country and have been accused of selling security tools that government uses for digital surveillance to Uganda and Zambia to spy on political opponents²⁸. Therefore, the spread of surveillance technology is making its way into Africa and will be important for the Nigerian government to address concerns and ensure that these companies are not selling their products to governments that may use them to suppress fundamental rights.

Challenges to advancing AI in Nigeria

Along with the risks of AI, there are several challenges that make it difficult to grow AI in Nigeria. First, developers receive most of their funding from foreign investors²⁹. To give an idea of the volume, foreign investment accounted for 98% of the total funds raised by startups in Nigeria in the second quarter of 2018. It is not a matter of these startups having access to local investors. There are many wealthy Nigerians who are potential investors, but they are reluctant to invest in tech startups because they do not understand the concepts and opportunities in this space with a strong perception of it being extremely high risk.³⁰ This makes it difficult to grow AI in Nigeria because building the ecosystem with foreign capital means that intellectual capital, proprietary assets, and data will be domiciled offshore such that local problems and its subsequent solutions

²⁵ Robert Chesney & Danielle Kriton, (2018). Disinformation on Steroids. <https://www.cfr.org/report/deep-fake-disinformation-steroids>

²⁶ Kalev Leetaru. (2019). "The real danger today is shallow fakes and selective editing not deep fakes." From: <https://www.forbes.com/sites/kalevleetaru/2019/08/26/the-real-danger-today-is-shallow-fakes-and-selective-editing-not-deep-fakes/#45ebde2b4ea0>

²⁷ Steven Feldstein. "The Global Expansion of AI Surveillance." Carnegie Endowment for International Peace. (2019). From: <https://carnegieendowment.org/2019/09/17/global-expansion-of-ai-surveillance-pub-79847>

²⁸ Huawei, Africa and the global reach of Surveillance technology. From: <https://www.dw.com/en/huawei-africa-and-the-global-reach-of-surveillance-technology/a-50398869>

²⁹ Adeyemi Adepotun (2019). "Nigeria: Local Funding Slows As Tech Startups Raise U.S.\$95 Million Offshore." <https://allafrica.com/stories/201902140680.html>

³⁰ Founder of Paga, Taya Oviso says: "A commonly held view is wealthy Nigerians' reluctance to publicly invest and champion local startups is rooted in a lack of understanding. They're just not used to the asset class. That attitude contrasts heavily with wealthy persons in more advanced economies who are active in startup investment."

(if any) will be owned and controlled by foreign companies³¹.

Second, most schools in Nigeria use an old curriculum - one that does not reflect present day advances. While some are still relevant, many of the courses, especially in computer science, are outdated and have not kept up with the growing interest in AI. A majority of software engineers interviewed have grown their interest in AI independent of Nigeria's education curriculum with the belief that adding AI tools to their skillset will make them more desirable job candidates in the future.

Third, despite free courses offered primarily by international private sector organisations and some local startups, our internal research found that developers and aspiring AI developers (especially those new to AI and even computer science) face numerous hurdles when attempting to use these resources:

- Identification and Selection: Given the volume of free courses available, developers struggle to understand which course is the best.
- Guidance: Given the volume of free courses, developers and aspiring developers struggle to determine which combination of courses will give them the necessary skills to be employable.
- Verification & Certification: For Computer Science students who have not yet completed their degree or people who have never pursued a degree in computer science, it's important that in finding a course, they get one that provides certification as proof of knowledge.
- Coaching & Mentorship: Access to mentors and the struggle to figure out who to reach out to if one needs help or has questions (especially when errors occur) is a hurdle for many developers.
- Dataset costs, memory, and model processing: Datasets (for example, on Kaggle) have an impact on how much data (cost of internet) is needed to download it, how much memory it occupies, and how much processing power is required. All of these create another challenge to AI development.

Since education is fundamental, these challenges serve as impediments to growing AI in Nigeria.

³¹ Why Nigeria's Tech Ecosystem Shouldn't Be Build Exclusively With Foreign Capital. From: <https://techcabal.com/2018/09/21/why-nigerias-tech-ecosystem-shouldnt-be-built-exclusively-with-foreign-capital/>

Future state of AI: Suggested actions

Prioritize fairness

As with other transformative technologies, AI presents many opportunities to solve important problems and unlock societal and economic value. Given the diversity of languages, access to resources, literacy, and economic status in Nigeria, who gets access to AI and how they use it will become one of the most important areas for the Nigerian government to address in the future. With the potential for AI to impact society, it is important for technologists to understand their models in a social context. There presents an opportunity for the government to articulate and reinforce the country's social values, thereby evolving the discussion about machine learning fairness from a technical to a sociotechnical one. This type of social consensus could help guide technologists to follow a non-discriminatory approach when creating machine learning models and will better help us understand the ways in which algorithms can make life more fair in places in Nigeria.

Help increase understanding and communication of AI

AI can be a great benefit to society and it is critical that the public and policymakers understand its promise. Our internal research suggests that awareness and understanding of AI among consumers is limited. Dystopian fears in Nigeria, which have been fueled by science fiction movies, can distract from less vivid but more immediate dangers such as the risk of bias and malicious use. The government has an important role to play by acknowledging and addressing these concerns and providing an accurate, fact-based picture of the opportunities and challenges AI presents. Enabling an understanding of the value of AI has the potential to unlock investment opportunities locally and improving communication around AI by partnering with the government will provide a wider reach and impact of this effort. Other ways in which we could explore partnerships with the government is in helping to identify ways to include AI in the learning curriculum, to promote data privacy as a way to allay the fears of advancements in technology, and to support efforts where AI in Nigeria is gaining momentum.

Foster AI talent

The education system is extremely important because it is the catalyst through which technological understanding spreads. Education must work and serve as a tool for national inspiration. We need to revisit the learning curriculum, starting at the high school level, and revolutionize STEM education. At a press conference in 2018³², The Minister of Communications, Mr. Adebayo Shittu, expressed that the government will broaden the nation's focus on STEM (Science, Technology, Engineering and Mathematics) to include AI and further urged the audience to be digitally literate and allow children to take coding classes.

³² Federal Ministry of Communications, "Shittu Charges Private Sector to Lead in Artificial Intelligence," from <http://www.commtech.gov.ng/news-and-media/daily-news-report/187-shittu-charges-private-sector-to-lead-in-artificial-intelligence.html>

Education and technology have liberalized university education with Nigerians studying online, mostly free to subsidized from global institutions. The government must continue to make it as easy for Nigerians to consume higher education online as it is to consume the one offered by universities and institutions all over the globe.

There is also a possibility for AI to be used to help teachers streamline their instruction process to help students receive more personalized help more effectively.

Democratize data and encourage responsible data sharing

Data is the foundation of every machine learning model. Given that AI is growing in Africa, many industries still have limited access to datasets that are representative of African use cases.

- **Diverse and open datasets:** In order to grow the AI opportunity in Nigeria, it is important to increase the diversity of anonymized, visual and language data by making datasets more publicly available and open. One way to achieve this is to explore mechanisms for data sharing that are private and will help mitigate the burden of negotiating these transactions, such as the Open Data Institute (ODI) research program on data trusts³³. Another way to increase the visual and lingual diversity of training data for machine learning through community partnerships such as crowdsourcing, which may help reduce bias and give developers the opportunity to solve problems that are locally relevant.
- **Enabling balance of usability, shareability and people's privacy:** Governments can help by making it easier to create, share, and re-use datasets in a manner that still maintains privacy. This could be achieved if we avoid exposing personally identifying information when it is not relevant to the machine learning model, which is offered by open-source machine learning platforms such as TensorFlow³⁴.
- **Addressing dataset bias through partnerships:** Boosting training data through targeted crowdsourcing, partnerships with community organizations and training models to account for bias might reduce unfair bias and give developers the opportunity to solve problems that are locally relevant.

Focus on impact

The benefits of AI will only become actualized if it is applied in a meaningful way and if people everywhere have access to education to participate as creators and not only consumers. AI in Nigeria is gaining momentum and government support in areas that are pertinent to the Nigerian people, such as agriculture and healthcare. Governments can act as a useful signpost in nudging businesses to explore and invest in these type of AI opportunities while sharing best practices and standards. Businesses should also continue to invest in these areas and partner with the government to ensure these efforts are funded. Some helpful resources that encourage

³³ Open Data Institute, Defining a 'data trust,' from: <https://theodi.org/article/defining-a-data-trust/>

³⁴ Tensorflow is an end-to end open source machine learning platform: <https://www.tensorflow.org/>

responsible development of AI are the Responsible AI Practices³⁵ and the People + AI Guidebook³⁶.

Leverage explanations to help build trust

Since the dawn of the computing revolution, the underlying programming that has guided mechanical thinking machines was provided by humans. Concerns about unfair bias, flawed representations, and putting trust in AI systems have led to growing interest in “explainable AI.” Given that AI-driven systems are based on probability and uncertainty, the right level of explanations are critical in helping people understand how the system works³⁶. It is equally important that people avoid implicitly trusting AI systems in all circumstances, but rather calibrate their trust appropriately. As companies like Google roll out explainable AI tools like its “What-If Tool³⁷,” technologists should focus on ways to leverage explanations to help people understand an AI-driven system’s capabilities and limits.

Furthermore, governments should identify ways to keep developers of AI accountable and informed about the ways bias can play a role in the machine learning process, including the datasets for training models. Consistent with Google’s AI Principles³², we encourage developers of AI to design AI systems that provide appropriate opportunities for feedback, relevant explanations, and appeal. This ensures AI technologies will be subject to appropriate human direction and control.

Conclusion

This paper highlights what Google considers to be some of the critical issues and questions in the development of AI in Nigeria. We hope it is useful as policy makers in the country continue to have conversations about laws, regulations, and governance around AI today. We welcome further advice, recommendations, and partnerships we need to consider to successfully grow AI in Nigeria in a responsible way.

³⁵ Google AI, Responsible AI Practices, from: <https://ai.google/responsibilities/responsible-ai-practices/>

³⁶ People and AI Research Guidebook, from: <https://pair.withgoogle.com/>

³⁷ Google “What If Tool,” from: <https://pair-code.github.io/what-if-tool/>