Republic of Ghana National Artificial Intelligence Strategy: 2023-2033

To harness AI for inclusive growth across all sectors and to improve the lives of people in Ghana, becoming a trailblazer for AI leadership in Africa and beyond.

Developed by the Ministry of Communications and Digitalisation with Smart Africa, GIZ FAIR Forward, and The Future Society (TFS)

October 2022

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Foreword

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List of Abbreviations

AfCFTA	Africa Continental Free Trade Area
AI	Artificial Intelligence
AI4D	Artificial Intelligence for Development
AIMS	African Institute of Mathematical Sciences
AITI-KACE	Ghana-India Kofi Annan Centre of Excellence in ICT
AU	African Union
AWS	Amazon Web Services
BDC	Bureau of National Communications
BoG	Bank of Ghana
DFS	Digital Financial Services
DTT	Digital Terrestrial Television
ECG	Electricity Company of Ghana
FDI	Foreign direct investment
FTA	Free-to-Air
GDPR	General Data Protection Regulation (EU)
GIFEC	Ghana Investment Fund for Electronic Communications
GIZ	German Corporation for International Cooperation GmbH
GoG	Government of Ghana
GRIDCO	Ghana Grid Company Limited
GTL	Ghana Tech Lab
IEAI	Institute for Ethics in Artificial Intelligence
ICT	Information and Communications Technology
ICT4AD	ICT for Accelerated Development
ISP	Internet Service Provider
IT	Information Technology
KNUST	Kwame Nkrumah University of Science and Technology
KPI	Key Performance Indicator
MDAs	Ministries, Departments and Agencies
MESTI	Ministry of Environment, Science, Innovation & Technology
MMDAs	Metropolitan, Municipal and District Assemblies
ML	Machine Learning
MoCD	Ministry of Communications and Digitalisation
MoF/MoFEP	Ministry of Finance and Economic Planning
MOOC	Massive Open Online Course
NCA	National Communications Authority
NITA	National Information Technology Agency
NLP	Natural language processing
PoC	Proof of Concept
PPP	Public-Private Partnership
PPPP	Public-Private-People Partnership
PSSA	Payment Systems and Services Act
SADA	Smart Africa Digital Academy
SDG	Sustainable Development Goal
SME	Small and medium-sized enterprise
STEM	Science, technology, engineering, maths
STI	Science, Technology, Innovation
SWOT	Strength, Weaknesses, Opportunities, Threats
TVET	Technical and Vocational Education and Training
TFS	The Future Society
UMaT	University of Mines and Technology
VRA	Volta River Authority
YEA	Youth Employment Agency

Executive Summary

Ghana's national, economic, and sustainable development objectives could be accelerated through the application of artificial intelligence (AI). A national AI strategy that builds upon existing digital policies and aligns key stakeholders will serve as a transformative catalyst for Ghana's AI ecosystem and leadership position in Africa.

The Government of Ghana, through the Ministry of Communications and Digitalisation, led the development of Ghana's National AI Strategy, with support from GIZ FAIR Forward, Smart Africa, and facilitation from The Future Society (TFS). The project is grounded in extensive consultations with stakeholders and analysis of the country's AI and digital ecosystem and policy landscape.

Mission: "To harness AI for inclusive growth across all sectors and to improve the lives of people in Ghana, becoming a trailblazer for AI leadership in Africa and beyond."

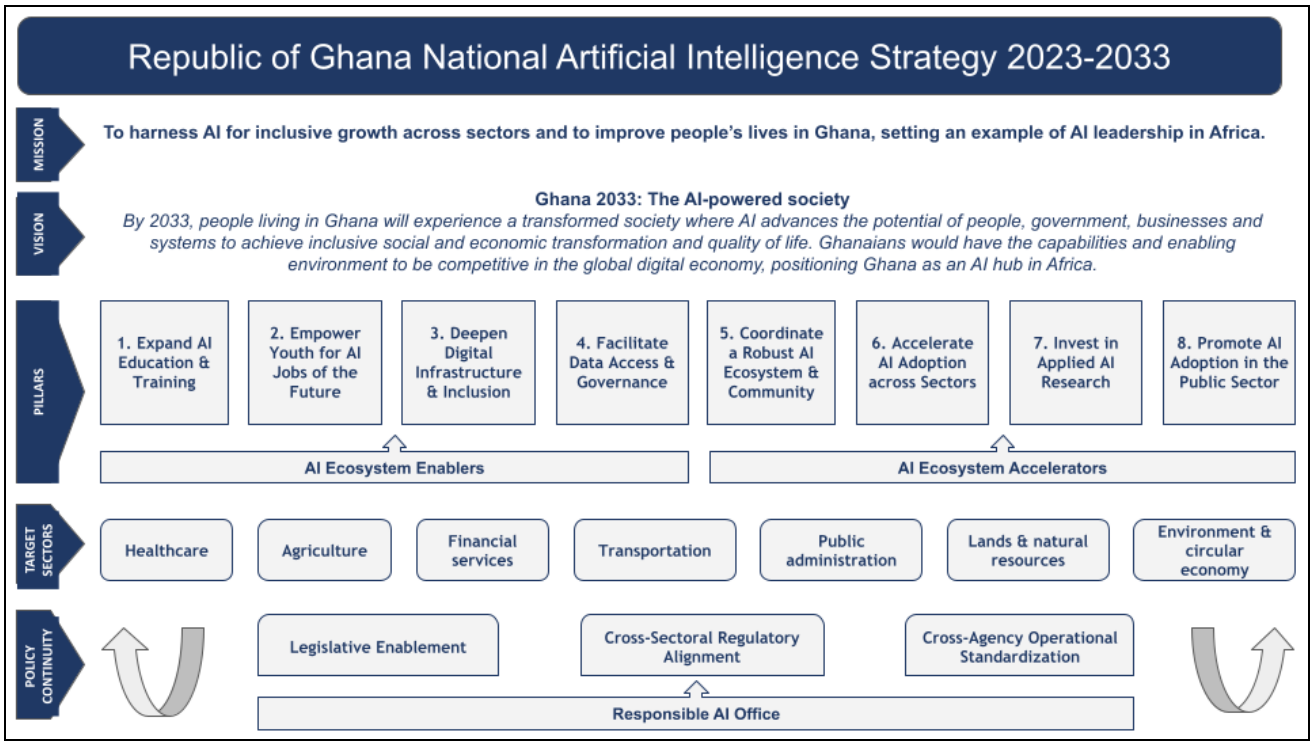
Vision "Ghana 2033: The Artificial Intelligence-Powered Society: By 2033, people living in Ghana will experience a transformed society where AI advances the potential of people, government, businesses and systems to achieve inclusive social and economic transformation and quality of life. Ghanaians would have the capabilities and enabling environment to be competitive in the global digital economy, positioning Ghana as an African AI hub."

As described in Smart Africa's *Blueprint: Artificial Intelligence for Africa* report[1], AI brings major opportunities to Africa to achieve sustainable growth and development. The expansion of digital connectivity, the accumulation of more data, the development of more sophisticated algorithms, and the increase in computing power are facilitating AI's technological advancements. Most AI development and use is happening in advanced economies right now, but AI has a lot of potential to change emerging economies as well. Ghana possesses a variety of advantages and strengths that can be utilised to facilitate the development of a local Ghanaian AI ecosystem. Nevertheless, as much as AI wields positive transformative power, it also poses risks that could compromise security, safety, privacy, and human rights, as well as lead to biassed decision-making and data abuse. It is imperative for Ghana to ensure a responsible, inclusive, and sustainable AI ecosystem. Consequently, data governance and policy are essential for fostering Ghana's AI ecosystem and mitigating its many risks.

The strategy document includes insights derived from a diagnostic assessment (SWOT Analysis) that identifies significant opportunities and constraints that AI developers in Ghana must contend with. The SWOT analysis revealed policy intervention areas required to accelerate, enable, and scale Ghana's AI ecosystem. As such, it serves as the foundation for policy recommendations centred on capitalising on the ecosystem's strengths, overcoming its weaknesses and threats, and capitalising on unique opportunities.

[1]Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.

In addition, eight essential pillars for a responsible and inclusive AI ecosystem in Ghana were established. Notably, these overlap with the pillars identified in the "AI for Africa Blueprint" report by Smart Africa. [2]



Furthermore, the strategy document (Appendix 1) explores practical use cases for the adoption of AI in the real world that can boost productivity, efficiency, and outcomes in a number of critical sectors of the Ghanaian economy.

Booklet of AI Use Cases in Ghana

- **AI in Healthcare**
- **AI in Smart Electricity Grid**
- **AI in Environment & Circular Economy**
  - Air Quality Monitoring
  - Recycling
  - Smart water management
- **AI in Transportation**
  - Urban Traffic Management System
  - Smart Vehicle Fleet Management System
- **AI in Financial Services**
- **AI in Agriculture**
  - Increasing Crop Yields
  - Soil Management
  - Farm Management
  - Detecting Food Fraud
- **Land & Natural Resources**
  - Simulation Modelling of Landscape and Settlement Distribution
  - Land Use and Development
  - Wildlife and Forest Conservation

[2]Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.

Key Recommendations

Pillar 1: Expand AI Education & Training	1. Conduct an annual skills gap assessment. 2. Launch the “AI Ready Ghana” programme. 3. Expand the number of AI education courses available. 4. Promote training courses for teachers.
Pillar 2: Empower Youth for AI Jobs of the Future	5. Facilitate remote jobs or internships in AI. 6. Develop tax incentives for youth in AI start-ups to promote employment. 7. Develop AI Fellowship programs. 8. Support continuous training and short courses for students and professionals to enter the AI field.
Pillar 3: Deepen Digital Infrastructure & Inclusion	9. Review and identify gaps in the implementation of existing digital policies including development of national data centres. 10. Initiate mutual partnerships engagement with world-class cloud computing providers for affordable access for AI start-ups in Ghana. 11. Orchestrate market dynamics that incentivise entrepreneurs to start enterprises that focus on AI products and services.
Pillar 4: Facilitate Data Access & Governance	12. Disseminate and drive enforcement of existing data sharing & governance policies. 13. Clarify data privacy and data sharing agreements and regulations for partnerships. 14. Disseminate guidance on trustworthy, safe, secure and ethical AI practices to AI developers and adopters. 15. Apply to international and regional AI governance platforms. 16. Rollout of the Ghana Open Data Initiative (GODI), the Ghana Data Exchange Hub and data repositories.
Pillar 5: Coordinate a Robust AI Ecosystem & Community	17. Build & convene an online and in-person AI community. 18. Expand and establish complementary physical or virtual AI innovation hubs across the country, especially in marginalised communities, to promote collaborations and knowledge sharing.
Pillar 6: Accelerate AI Adoption in Key Sectors	19. Spark investment into AI adoption with 5 AI pilot projects from across key sectors. 20. Review and clarify laws for copyright, patents and intellectual property. 21. Implement incentives for AI start-ups, e.g. tax breaks for research & development or employment.
Pillar 7: Invest in Applied AI Research	22. Establish a Special Research Initiative to delve into climate-smart agriculture and forestry. 23. Establish a Natural Language Processing (NLP) Centre of Excellence (CoE). 24. Develop a framework for the establishment of a National Deep Science Institute.
Pillar 8: Promote AI Adoption in Public Sector	25. Develop a program that increases access for digital & AI-focused start-ups to public procurement processes.

	26. Evolve public sector mindset to view algorithms as IP and work with vendors & start-ups to co-create IP in AI. 27. Establish a program to train civil & public servants to design, lead and implement AI projects in public services. 28. Incentivise an AI culture by creating a reward system to encourage service delivery excellence utilising AI. 29. Develop a comprehensive public administration data dashboard/interface to provide data analytics for policy, planning, programme mix, resource allocation, monitoring, and evaluation. 30. Initiate a programme to identify critical public service AI use-cases. 31. Develop a viable workflow and operational framework for public sector work that takes into consideration agility and data-driven decision making.

The report concludes with a recommendation that a Responsible AI Office (RAI Office) be established within the first year to lead the execution of the Ghana National AI Strategy. The RAI Office shall be mandated with implementing the National AI Strategy by coordinating institutional stakeholders and championing the responsible development and deployment of artificial intelligence. Furthermore, the office will oversee ongoing monitoring and evaluation of the progress of Ghana's AI efforts. The RAI Office will be established as an independent, well-resourced institution tasked with driving implementation. This office is modelled on the Singapore National AI Office (NAIO), the Egypt National AI Council, and the United Kingdom's Office for AI.

Ghana has a momentous opportunity to build upon its burgeoning AI and digital ecosystem. By launching the Responsible AI Office, coordinating key actors and driving action, the Government of Ghana accelerates responsible and trustworthy AI adoption to achieve inclusive growth across sectors, improving the lives of people in Ghana and becoming a trailblazer for AI leadership in Africa and beyond.

Acknowledgements

Through the Data Protection Commission, the Ministry of Communications and Digitalisation collaborated with Smart Africa, GIZ FAIR Forward, and The Future Society (TFS) to develop the Ghana National Artificial Intelligence Strategy. Numerous individuals and institutions contributed to the project's completion in a variety of ways.

We are indebted to HE Nana Addo Dankwa Akufo-Addo, President of the Republic of Ghana, for his visionary leadership that paved the way for this AI strategy initiative. In addition, the Vice President, HE Mahamudu Bawumia, is lauded for his office's contribution to the development of the Ghana National AI Strategy and tireless efforts to drive the digital transformation agenda in Ghana. In addition, the Minister of Communications and Digitalisation, Mrs. Ursula Owusu Ekuful (MP), is commended for being a guiding light, providing resources, and championing Ghana's artificial intelligence initiatives in the digital economy. Furthermore, the Deputy Minister of Communication and Digitalisation, Ms Ama Pomaa Boateng (MP), has been very supportive through her counsel, contributions, and welcoming presence throughout the development of this strategy, and we express our gratitude to her. Similarly, we recognise the efforts of Ms. Paricia Adusei-Poku, the Commissioner at the Data Protection Commission, who was a fundamental and mobilising leader in the development of the strategy, ensuring that the environment, cooperation, and personnel were always available throughout its development.

The project benefited from the leadership of the Ministry of Communications and Digitalisation, including Mrs. Magdalene Apenteng, who was the Chief Director of the Ministry at the beginning of the project, and Mr. Alfred Nortey, who was the Director of Research at the Ministry. The project team is represented by the Executive Director of the Ghana Data Protection Commission, Patricia Adusei-Poku, Maxwell Ababio, and Abigail Yeboah. The FAIR Forward project, a global initiative of the German Federal Ministry for Economic Cooperation and Development (BMZ) implemented by The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, was represented by Abraham Kuuku Sam, Jonas Gramse, Emmanuel Mumuni, Mary Afram and Raphael Leuner. The knowledge partner is The Future Society (TFS), led by Yolanda Lannquist, Nicolas Miailhe, Derrydean Dadzie, Robert Okine, and Badrul Chowdhury. The Smart Africa Alliance participated with representation by Olivier Gakwaya.

The working team benefited from consultation workshops and expert interviews with participants from the Ghanaian government's Ministries, Departments, and Agencies, including the Vice President's Office, the Ministry of Communications and Digitalisation, the Data Protection Commission, the National Information Technology Agency (NITA), the Ministry of Environment, Science, Innovation, and Technology (MESTI), the Ministry of Education, the Ministry of Transport, and the Ministry of Health.

The project additionally benefitted from stakeholder consultations and expert interviews with participants representing the private sector, academia and civil society organisations, including

but not limited to the Tony Blair Institute for Global Change, African Institute for Mathematical Sciences (AIMS), University of Cape Coast, Kwame Nkrumah University for Science and Technology (KNUST), the KNUST Responsible Artificial Intelligence Lab (RAIL), Responsible AI Network (RAIN) Africa, Ghana Chamber of Telecommunications, Mozilla Foundation, NVIDIA, Google AI, Ghana NLP, AmaliTech, Blossom Academy, Artificial Intelligence Association of Ghana, Cyst, mPharma, MinoHealth, Karagro AI, Developers in Vogue, Microsoft, Women in Machine Learning and Data Science (WiMLDS), in addition to Ghanaian AI practitioners, engineers and PhD researchers.

Context

The application of artificial intelligence (AI) has the potential to accelerate Ghana's movement toward achieving its economic and sustainable development goals (SDGs). The National AI Strategy of Ghana functions as a comprehensive roadmap that enables the country to capitalise on AI's socio-economic benefits while simultaneously mitigating its hazards. Artificial intelligence can boost human and economic development across Ghana in line with its national objectives, as well as progress towards the achievement of the United Nations Sustainable Development Goals (SDGs). Despite this, there are significant ethical dangers and practical obstacles associated with using AI, even though its opportunities are enormous. Expanding on digital policies and aligning key stakeholders, a national AI strategy and action plan will establish Ghana's regional AI ecosystem and leadership.

The Ghanaian government, acting through the Ministry of Communications and Digitalization, has been the driving force behind the creation of the country's National Artificial Intelligence Strategy. This work has been made possible with assistance from GIZ FAIR Forward and Smart Africa, and it has been facilitated by The Future Society (TFS). The project required close coordination with the government of Ghana, which was represented by the Data Protection Commission (DPC) at the Ministry of Communications and Digitalisation. Additionally, the initiative engaged stakeholders from the local, regional, and international levels. Consequently, the National AI Strategy will position Ghana as a leader and harness AI for sustainable and inclusive growth, laying the groundwork for the future of the nation and the continent.

To date, the majority of African nations have yet to bring AI and digital technology advancements to policy tables. However, there is renewed impetus by some African countries such as Ghana, Rwanda, Kenya, Mauritius, South Africa, Tunisia, Morocco and Egypt to set the wheels of change in motion.[3] Smart Africa's *Blueprint: Artificial Intelligence for Africa* report[4] presents key elements and advice for national AI strategies and international coordination in Africa.

What is AI?

AI broadly refers to "an array of technologies relying on algorithms at their core to 'think' or 'act' towards solving a problem. AI includes tasks such as learning, reasoning, planning, perception, language understanding, and robotics."[5] Machine learning (ML) is the sub-set of AI which has garnered the most traction and enthusiasm in recent years, creating opportunities for rapid AI developments and applications.

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[3] https://oecd.ai/en/dashboards and The Future Society.
[4] Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.
[5] Russell, Stuart (2016) "Q&A: The Future of Artificial Intelligence". University of California, Berkeley. http://people.eecs.berkeley.edu/~russell/temp/q-and-a.html.

AI includes many applications to improve outcomes and efficiency across sectors. These include, for example, language translation and customer service chat bots; prediction & optimization of electricity usage; autonomous vehicles & bus routes; facial recognition check-ins; predictive medical diagnoses for disease or triage; robotic process automation for businesses; virtual home voice assistants; analysis of satellite imagery to predict deforestation or agriculture outcomes; drone imaging for precision agriculture; algorithmic predictions for credit scoring or fraud detection; image classification for reading and digitising written text, and much more.

Mission and Vision Statements

Mission statement

To harness AI for inclusive growth across all sectors and to improve the lives of people in Ghana, becoming a trailblazer for AI leadership in Africa and beyond.

Vision statement

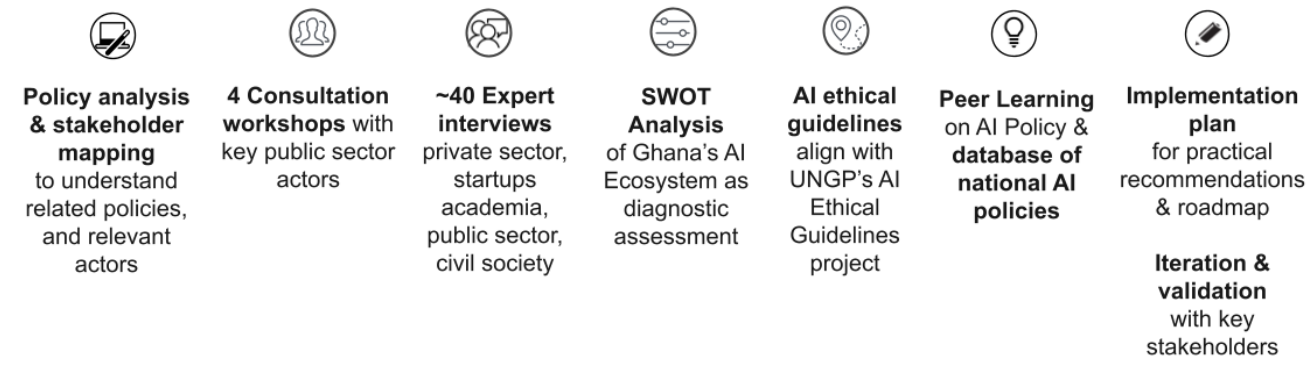
Ghana 2033: The AI-powered society:
By 2033, people living in Ghana will experience a transformed society where AI advances the potential of people, government, businesses and systems to achieve inclusive social and economic transformation and quality of life. Ghanaians would have the capabilities and enabling environment to be competitive in the global digital economy, positioning Ghana as an African AI hub.

Methodology

Ghana's National AI Strategy is grounded in stakeholder consultations and analysis of the country's AI and digital ecosystem and policy landscape (Appendix 2). Around 40 expert interviews were conducted with key actors and institutions in Ghana's AI ecosystem from the public sector, academia, start-ups and private sector and civil society, complemented by four high-level public sector consultation workshops.

The research involved deep engagement of stakeholders and in-depth cross-sectoral analysis of the AI ecosystem's strengths, needs, opportunities and challenges. Findings are presented in a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, which identifies the most urgent areas for reform to enable Ghana's AI ecosystem to flourish responsibly and inclusively. Background research also incorporates African and international emerging practices in AI policy based on benchmarks of various international AI strategies. A sectoral approach provides concrete examples of AI applications in key sectors in Ghana (Appendix 1 - Booklet of AI Use Cases in Ghana).

Public sector consultations and workshops were conducted to shape and prioritise actionable policy recommendations. An initial workshop in March 2022 with steering committee members defined mission and vision statements. Subsequent in-person and virtual public sector consultation workshops took place from May to October 2022.



AI for Sustainable and Inclusive Development

Around the world, AI is becoming increasingly pervasive in our lives as a "general-purpose technology." As described in Smart Africa's *Blueprint: Artificial Intelligence for Africa* report[6], AI brings major opportunities to Africa to achieve sustainable growth and development. Technological advancements in AI are being enabled by greater digital connectivity, increasing amounts of data, advanced algorithms, and gains in computing power. While most AI development and applications are currently in advanced economies, AI also has great potential to transform emerging economies.

Smart Africa's *Blueprint: Artificial Intelligence for Africa* report presents various AI applications and opportunities for African countries, from agriculture, education, health, financial services, energy and transportation and climate change. Similarly, the Global Partnership on AI (GPAI) has identified numerous applications of AI to help combat climate change and support the environment.[7] International research identifies numerous use cases across sustainable development goals.[8] This report provides concrete examples of AI applications in key sectors in Ghana (Appendix 1 - AI Use Cases in Ghana).

AI can be a launch pad for Africa to make a paradigm shift to more efficient, optimal and transparent delivery of public services and infrastructure development. For example, in the healthcare sector, structural inequalities, shortages of qualified healthcare professionals or supplies, barriers to accessibility, affordability and rural and urban divides raise critical gaps that AI can help address.[9] Investing in digital technologies, including AI, will prepare Africa to generate new economies and contribute and compete in a global economy. Strategic adoption of advanced digital technologies such as AI can provide employment opportunities for the youth and opportunities for the continent's innovators and entrepreneurs to plug into global value chains.

While the responsible adoption of AI has the potential to help the country by driving inclusive economic advancement, Ghana has not yet taken full advantage. The African continent as a whole still lags behind. A measure of Oxford Insights' governments' readiness for AI adoption revealed that the African continent scored the lowest on average. Moreover, few countries in the region have set out their vision for the implementation of AI.[10] Generally, African countries lack

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[6]Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.

[7] Global Partnership on AI, *Climate Change and AI,* https://www.gpai.ai/projects/climate-change-and-ai.pdf

[8] "Applying AI for Social Good | McKinsey." n.d. Accessed August 28, 2019. https://www.mckinsey.com/featured-insights/artificial-intelligence/applying-artificial-intelligence-for-social-good ;Vinuesa, R. et al (2019) The role of artificial intelligence in achieving the Sustainable Development Goals, online: https://arxiv.org/ftp/arxiv/papers/1905/1905.00501.pdf .

[9] Lannquist, Y., 2021, "Opportunities & Challenges of AI in Healthcare in Africa," The Future Society. https://thefuturesociety.org/2021/07/22/opportunities-challenges-of-ai-in-healthcare-in-africa/

[10] Oxford Insights and the International Development Research Centre. (2020). Government Artificial 2 Intelligence Readiness Index 2020. https://www.oxfordinsights.com/government-ai-readinessindex-2020

the preparedness to harness the tools that widespread adoption of AI would bring to solve many of the continent's most pressing social and economic challenges.[11]

Nonetheless, Ghana has numerous advantages and strengths that can be harnessed to enable a local Ghanaian AI ecosystem. For example, some notable AI activities in Ghana have stemmed from the setting up of Google's first AI centre in Africa in Accra. For Ghana to take advantage of its burgeoning AI community, supporting and developing a responsible AI ecosystem with long-term benefits is critical. While AI development is rapid, adoption and upscaling across markets are still at an early stage, and much of its value is yet to be tapped. Thus, Ghana has a window of opportunity to harness AI for inclusive growth, sustainable development and well-being.

Risks of AI

However, the opportunities of AI are connected with substantial ethical and societal risks, including bias, discrimination and lack of transparency & explainability in algorithmic outcomes, widening inequality gaps, cybersecurity, privacy and safety concerns, and gaps in inclusion and data governance. These require developing innovative AI governance, carefully balanced by ethical guidelines for responsible AI adoption.

AI systems can widen already existing inequalities and exclusion. Gaps in digital inclusion in rural areas and other demographic groups mean that certain populations are underrepresented in AI systems and unable to benefit from them. Meanwhile, Ghana suffers from a systematic lack of accurate and high quality data collection. Model bias can result in less accurate outcomes that are unsafe and unfairly discriminate against underrepresented groups. Currently, algorithmic bias can occur on data and models from foreign contexts that do not fit Ghana’s contexts.

Personal data is vulnerable to violations in privacy or security during data collection, sharing, processing and storage. Furthermore, AI-generated realistic text, audio and video (‘deep fakes’) and personalised disinformation campaigns can manipulate, persuade and deceive citizens. Meanwhile, the lack of transparency and explainability in some AI systems (e.g. neural networks and deep learning) makes it difficult to detect bias, audit and trust AI systems, and hold them accountable. As more and more basic and vital services will be based on AI and digital technologies, these service systems have a new and increased vulnerability. Moreover, AI can be used for social harm, citizen surveillance and infringe on individual privacy.

The AI economy can provide both job opportunities and losses across skill levels. From data collection and labelling to applied research, people in Ghana can participate in the global AI value chains. However, if the population is not prepared, automation of tasks in jobs can result in job losses. It is important to “future-proof” Ghana’s workforce by preparing them for future AI and digital jobs.

[11] https://ircai.org/wp-content/uploads/2021/03/AI4D_Report_Responsible_AI_in_SSA.pdf

It is imperative for Ghana to ensure a responsible, inclusive and sustainable AI ecosystem. As much as AI wields positive transformative power, it has the potential to infringe on human rights and lead to biased decision-making and misuse of data. To this end, data governance and policy are key to driving Ghana's AI ecosystem while mitigating its many risks.

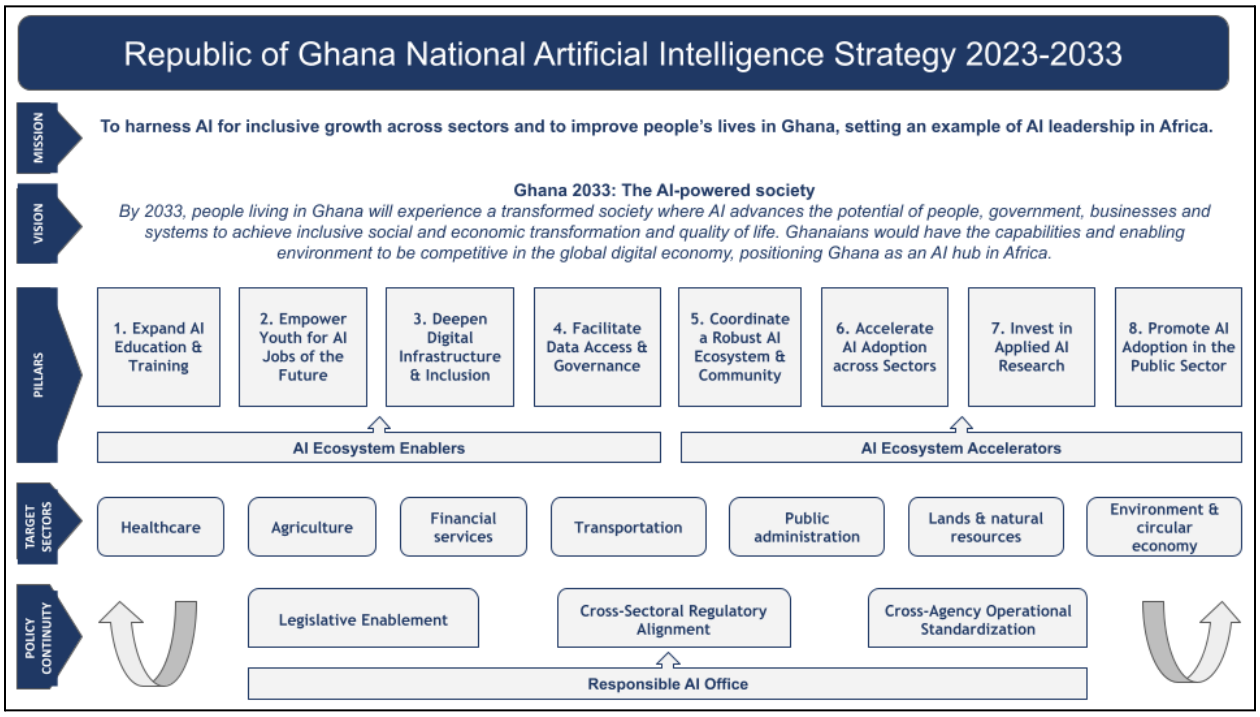
Diagnostic Assessment of Ghana's AI Ecosystem - SWOT Analysis

Strengths	**W**eaknesses
● Vibrant and growing digital, e-commerce and innovation start-up ecosystem, including accelerators and innovation hubs (E.g. Ghana NLP, Mazzuma, Artificial Intelligence Association of Ghana) ● Digital connectivity expansion including the availability of internet in urban areas (e.g. 800km fibre optic cables, submarine gateways via Eastern Corridor) ● Local digital hubs (e.g. Accra Digital Centre AI Lab) and business-friendly environment for international investment (i.e. Anglophone market, political stability and security, academic institutions, solid internet infrastructure, ease of visas) ● Growing international investment in AI and the digital landscape (e.g. Google, Twitter, Glovo) ● Presence of supportive global actors such as Tony Blair Institute for Global Change and Kofi Annan Centre (AITI-KACE) ● Hub in the West African sub-region is able to attract talent and lead by example ● Relatively strong availability of university graduates equipped with fundamental skills in computer science, data analysis, mathematics and other relevant courses ● Young and fast-growing population with a strong drive to advance and improve the country through AI and emerging technologies ● Existence of robust national vision, policies and objectives towards digital, ICT and innovation (e.g. Ghana Digital Economy Policy, Ghana Integrated Digital Transformation Blueprint) ● Championing data governance, digital development and e-payments in Africa ● The expansion of the market to the Africa Continental Free Trade Area (AfCFTA) with headquarters in Ghana	● Low awareness about opportunities and value of AI adoption, resulting in low demand for local AI projects and few job opportunities to develop human capital ● Skills gap and lack of appreciation or low political will among government actors to drive AI development. ● Lack of coordination and collaboration among actors in the AI ecosystem, including AI projects in universities, companies, and across public sector institutions ● Limited access and low affordability of, reliable electricity, high-speed internet and IT infrastructure, including cloud computing infrastructure and data centres for high-performance computing ● Low digital skills & literacy and smartphone penetration in rural areas are barriers to AI adoption in SMEs ● Insufficient local digitised datasets that are accurate, updated, and representative. ● Data is inaccessible across sectors. Lack of standard practices in data digitization, collection, and sharing; data is siloed in sectors ● Low awareness, compliance and enforcement of data privacy and cybersecurity policies & governance; telecommunications policies that do not align well with disruptions and new trends in the sector ● Public scepticism and the need to demystify AI trends, including impact on jobs. ● Limited availability of university professors, funding, and courses in AI; skills gaps and insufficient number of talent with data science and more advanced AI skills ● Gaps in internet coverage and lack of 5G. 4G penetration at 41% on average in rural areas compared to 88% in urban areas ● Lack of access to venture capital and traditional bank loans limit access to financing for start-ups ● Lack of large-scale, local AI projects by industry or local digital hubs

Opportunities	**T**hreats
● Leverage the growing, vibrant digital ecosystem, talent pool and international investment (e.g. Google, Twitter) for Ghana to become a hub and launchpad for AI solutions in the region and continent ● Adopting AI tools can drive inclusion, outcomes and efficiency gains across sectors, including healthcare, transportation, energy, agriculture, education and public services ● Professionals access remote international AI job opportunities to grow skills, employment, and support the local AI community ● Growing niche in natural language processing (NLP) AI methods, including collection and labelling of local languages for translation solutions and chatbots across sectors ● Skills and employment across the AI value chain and skills levels by training students in data science, data labelling and collection, data centre infrastructure and cloud services, cybersecurity, machine learning research and product development	● Lack of coordination and investment in implementing the National AI Strategy resulting in a failure of the AI ecosystem to take off, limiting Ghana's competitiveness in the global digital economy ● Low accessibility and inclusion in AI adoption due to gaps in digital skills and literacy in SMEs and rural areas ● Risk of failures, errors and discrimination due to lower accuracy of AI models trained on foreign data not fit for local context, and underrepresentation in digital inclusion and AI development ● Loss of data privacy, security and public trust due to misuse of data or limited guidance, legislation and compliance for trustworthy AI adoption ● Lack of coordination and implementation in existing policies results in inefficient and underutilization of resources ● Potential for job loss or unemployment in traditional jobs due to changing skills demand and automation ● Brain drain of AI talent due to opportunities abroad ● Limited long-term sustainability of initiatives financed by donor partners.

A diagnostic assessment (SWOT Analysis) identifies important opportunities and constraints that AI developers face in Ghana. It identifies the areas requiring policy interventions to accelerate, enable and scale Ghana's AI ecosystem. As such, it is the foundational knowledge base for policy recommendations to harness Ghana's strengths, overcome its weaknesses and threats, and ultimately take advantage of important opportunities for an AI ecosystem.

National AI Strategy Framework



The framework includes eight key pillars to enable a responsible and inclusive AI ecosystem in Ghana. Several of the pillars overlap with the five pillars identified in Smart Africa's "AI for Africa" Blueprint report: *Human capital, From Lab to Market, Networking, Infrastructure, and Regulation*.[12]

Pillar 1: Expand AI Education & Training

In an era of rapid technological and economic changes, it is essential to equip people in Ghana with the skills to survive and thrive - now and in the future. This pillar develops AI talent by increasing the number of graduates with AI and machine learning, data science, data engineering, computer science, and practical technical skills (e.g. data preparation, data collection and labelling). By increasing AI talent, individuals and the nation can participate in the global AI and digital economy. Inclusive education programmes in rural areas and women are essential to diversifying the AI field. Furthermore, this pillar prepares the workforce for an evolving labour market and skills requirements.

Pillar 2: Empower Youth for AI Jobs of the Future

Youth employment is a key national objective. Youth in Ghana have opportunities to participate in the AI value chain, in Ghana and at international levels. Across skill and education levels, youth can participate in data collection, labelling, applied data science, machine learning research and beyond. In doing so, they create local home-grown datasets and AI solutions fit for

[12]Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.

the context. Youth can participate in a growing global digital and AI economy while staying within Ghana and contributing to its economy and AI community in either remote or local AI projects. Increasing opportunities for the youth of Ghana to learn and develop in-demand skills helps future-proof Ghana's competitiveness, prevent brain drain and job displacement from automation.

Pillar 3: Deepen Digital Infrastructure & Inclusion

Reliable digital infrastructure and digital inclusion are fundamental for robust and inclusive AI in Ghana. This pillar enables greater access to internet and digital infrastructure, hardware and cloud computing services. Internet penetration is incomplete, particularly in rural areas, and poses challenges in terms of affordability and reliability with consequences for inclusion. Similarly, access to international world-class cloud service providers is unaffordable for AI start-ups, students and practitioners. International cloud providers offer compute capabilities that are unmatched by domestic options in terms of reliability, quality, efficiency, security and scalability. A path to affordable access to world-class compute for AI/ICT start-ups and companies while mitigating risks related to security and privacy is necessary. In parallel, Ghana will prepare to build a national cloud infrastructure with AI-ready storage and compute capacity serving the region and the continent.

Pillar 4: Facilitate Data Access & Governance

Access and availability of accurate and quality data are critical for AI. Ghana requires collecting and labelling more local data sets to support home-grown local AI solutions fit for the context. Despite existing data policies, institutions are largely unprepared to responsibly share data across organisations or with AI researchers and practitioners. Implementation and compliance with data privacy laws, cybersecurity and governance frameworks are necessary to facilitate access to data across institutions and providers while safeguarding citizens' privacy, safety, security and rights. Governance is needed to protect people in Ghana against risks presented by AI and create an enabling environment for trustworthy innovation.

Pillar 5: Coordinate a Robust AI Ecosystem & Community

While Ghana has a growing AI ecosystem, including strong AI start-ups, practitioners and university research programs (Appendix 2), the community is not in regular communication and therefore does not benefit from knowledge sharing and collaborations. Coordination of the AI community in events, meetups, projects, conferences and beyond can foster shared skills development, collaborative projects, and synergies to grow the AI ecosystem. AI practitioners can identify project partners and resources and coordinate toward exemplary and successful projects. A coordinated community also supports talent retention in Ghana.

Pillar 6: Accelerate AI Adoption in Key Sectors

The private sector plays a vital role in scaling up AI adoption across the economy and society. This pillar aims to accelerate the application of AI to boost productivity and outcomes in key sectors and AI entrepreneurship. Exemplary successful pilot projects can raise interest in AI applications across sectors, such as healthcare, agriculture, transportation, energy, financial services, and the environment. Numerous actors in Ghana's AI ecosystem are identifying use

cases to add value and address local challenges in these sectors. It is important to raise awareness and demystify AI to spark interest and investment in pilot projects.

With more projects available, local AI talent gain practical skills and job opportunities and are likely to stay in Ghana and contribute to the local economy. Notably, partnerships and coordination with public sector institutions and universities for sectoral applications are crucial to synergize in R&D, data, funding, and logistics to achieve scalability. This report provides concrete examples of AI applications in key sectors in Ghana (Appendix 1 - Booklet of AI Use Cases in Ghana).

Pillar 7: Invest in Applied AI Research

Ghana's AI ecosystem should be future-oriented and able to drive value and progress towards local challenges and sustainable development. Rather than adopting technologies primarily made in foreign countries, local research into deep tech and applications is best able to address the country's unique challenges and contribute toward African and international outcomes. This pillar focuses on applied research concerning AI applications in key sectors, such as agriculture, health, the environment, and deep science. It seeks to build on Ghana's existing strengths, such as natural language processing (NLP) within academic and corporate institutions.

Pillar 8: Promote AI Adoption in the Public Sector

This pillar aims to support public sector leadership in the responsible and ethical adoption of AI. AI brings opportunities to improve quality and access to goods and services through a large number of use cases across public services, from administration and planning to healthcare, transportation, education, and beyond. Performance and efficiency gains through the application of AI technologies can help overcome shortages of resources. Public sector leadership can set an example and drive demand for AI in the economy through public procurement and PPPs that are open to AI start-ups and innovative companies. Importantly, cross-sector collaboration and standardisation in operational models across institutions will ensure uniformity. Skills building and training across the public sector are important to build capacity for responsible and ethical AI adoption across Ghana.

8 Pillars: Key Policy Recommendations

Pillar 1: Expand AI Education & Training	1. Conduct an annual skills gap assessment. 2. Launch the “AI Ready Ghana” program 3. Expand education courses in AI 4. Promote training courses for teachers
Pillar 2: Empower Youth for AI Jobs of the Future	5. Facilitate remote jobs or internships in AI 6. Develop tax incentives for youth in AI start-ups to promote employment 7. Develop AI Fellowship programs 8. Support continuous training and short courses for students and professionals to enter the AI field
Pillar 3: Deepen Digital Infrastructure & Inclusion	9. Review and identify gaps in the implementation of existing digital policies including development of national data centres 10. Initiate mutual partnerships engagement with world-class cloud computing providers for affordable access for AI start-ups in Ghana 11. Orchestrate market dynamics that incentivise entrepreneurs to start enterprises that focus on AI products and services
Pillar 4: Facilitate Data Access & Governance	12. Disseminate and drive enforcement of existing data sharing & governance policies 13. Clarify data privacy and data sharing agreements and regulations for partnerships 14. Disseminate guidance on trustworthy, safe, secure and ethical AI practices to AI developers and adopters 15. Apply to international and regional AI governance platforms 16. Rollout of the Ghana Open Data Initiative (GODI), the Ghana Data Exchange Hub and data repositories
Pillar 5: Coordinate a Robust AI Ecosystem & Community	17. Build & convene an online and in-person AI community 18. Expand and establish complementary physical or virtual AI innovation hubs across the country, especially in marginalised communities, to promote collaborations and knowledge sharing
Pillar 6: Accelerate AI Adoption in Key Sectors	19. Spark investment into AI adoption with 5 AI pilot projects from across key sectors 20. Review and clarify laws for copyright, patents and intellectual property 21. Implement incentives for AI start-ups, e.g. tax breaks for research & development or employment
Pillar 7: Invest in Applied AI Research	22. Establish a Special Research Initiative to delve into climate-smart agriculture and forestry 23. Establish a Natural Language Processing (NLP) Centre of Excellence (CoE) 24. Develop a framework for the establishment of a National Deep Science Institute

Pillar 8: Promote AI Adoption in Public Sector	25. Develop a program that increases access for digital & AI-focused start-ups to public procurement processes 26. Evolve public sector mindset to view algorithms as IP and work with vendors & start-ups to co-create IP in AI 27. Establish a program to train civil & public servants to design, lead and implement AI projects in public services 28. Incentivise an AI culture by creating a reward system to encourage service delivery excellence utilising AI 29. Develop a comprehensive public administration data dashboard/interface to provide data analytics for policy, planning, programme mix, resource allocation, monitoring, and evaluation 30. Initiate a programme to identify critical public service AI use-cases 31. Develop a viable workflow and operational framework for public sector work that takes into consideration agility and data-driven decision making

AI Adoption in Key Sectors

AI adoption can support productivity, efficiency and outcomes in a number of critical sectors of the country. Examples of concrete AI applications are outlined in *Appendix 1- Booklet of AI Use Cases in Ghana*.

Target Sectors for AI Adoption
Healthcare
Agriculture
Transportation
Energy
Financial Services
Lands and Natural Resources
Environment and Circular Economy

Driving Implementation: Ghana's Responsible AI Office

This report recommends establishing a Responsible AI Office (RAI Office) during the first year to spearhead implementation of the Ghana National AI Strategy. The RAI Office shall be mandated to implement the National AI Strategy by coordinating stakeholders across institutions and championing AI's responsible development and deployment. Coordination of ongoing monitoring and progress measurements will also fall under the purview of the office. The RAI Office is to be established as an independent, well-resourced entity mandated to drive implementation. To support its launch, the Data Protection Commission may act as a nurturing enclave and incubator to form the institution and position it to acquire the necessary capacity for its mandate.

This office follows several international examples, such as the Singapore National AI Office (NAIO), Egypt National AI Council, and the United Kingdom's Office for AI. To be confirmed as part of the RAI Office's preliminary activities are:

1. Develop agenda to ensure **legislative enablement, cross-sectoral regulatory alignment** and **cross-agency operational standardisation**.
2. **Coordinate across institutions to implement** the National AI Strategy, involving government ministries and agencies, the private sector, academia and civil society, with an added dimension to ensure AI initiatives are useful and valuable to people and businesses. Responsible for leading several national AI strategy recommendations.
3. Lead quarterly **monitoring, measurement, and iteration** of the National AI Strategy, including identifying responsible actors, drawing up budgets, undertaking gap analyses, and reviewing, collating and updating emerging technology trends in Ghana and abroad.
4. Conduct **deeper analyses for market sizing opportunities** for AI across sectors.
5. Develop context-relevant indices such as a **Ghana AI Readiness Index** and toolkit to position Ghana, set goals & targets, measure progress and attract investment. Learn from international examples such as Rwanda's AI Readiness Index or The Global Index on Responsible AI.
6. Actively **participate in the global governance of AI** platforms such as Global Partnership on AI or OECD Working Party on Artificial Intelligence Governance (AIGO) to shape international AI policy and learn from countries' practices. With Smart Africa and GIZ FAIR Forward, participate in peer learning in the Africa-Asia AI Policy Maker Network. Following examples, such as Egypt's National Artificial Intelligence Strategy, **coordinate with international organisations** (e.g. Smart Africa, African Union).

It is strongly suggested that The RAI Office be equipped with a public-facing internet portal that displays its activities and agenda and facilitates community debates. The RAI Office will be evaluated over the course of three years with the goal of transforming it into a full commission as a means of affirming the government's ambition, AI leadership, and commitment to becoming Africa's AI hub.

Action Plan

Pillar 1: Expand AI Education

Outcome	Recommendation	Activities	Actor(s)	Year
A pool of talent ready to work in AI	Annual AI skills gap assessment	**1. Conduct an annual skills gap assessment.** • Conduct a baseline study to identify the current needs and availability of talent with specific skills and competencies for AI in the labour market to inform curricula in schools and universities. • Develop a framework for a 5-yearly baseline assessment and adjustment for AI skills and capacity. • Consultations with associations and institutions e.g. MESTI's Strategic Technology Centre & Decade of Innovation strategy, TVET, COTVET, and Association of Ghana Industries to build a database of industry skill demands.	MOCD, Ministry of Education, The National Council for Curriculum and Assessment (NACCA), Ghana Technology and Business Hubs Associations, Ghana Tertiary Education Council, MESTI, AITI-KACE, National Accreditation Board, universities (e.g. KNUST, Ashesi University, University of Cape Coast, University of Ghana, AIMS, Academic City University College)	2023
	"AI Ready Ghana" program to train students	**2. Launch the "AI Ready Ghana" program** • Launch an Initiative that aims to train over 1,000,000 AI-ready youth by 2033. The Initiative would ensure AI training for youth in the first year of high school through their last years in tertiary education. • Update existing STEM and IT curricula in secondary education to incorporate practical coding and AI skills, basics of data ethics, data protection and data science, and raise awareness about jobs in AI and digital fields. • Prepare students by incorporating the basics of data science and coding in primary education. • Develop a digital counselling and career advisory framework to guide young people on career choices	MoCD with Ministry of Education, Ghana Education Services, Ghana Tertiary Education Council, National Youth Authority (NYA)	2023

		in the digital economy. Such a framework should be implemented across all secondary and tertiary institutions through their career counselling units or departments where they exist. Where such offices do not exist, steps shall be taken to establish one.		
	AI education courses	**3. Expand education courses in AI** ● Coordinate among universities to create a database of existing universities, technical universities and vocational training courses and degree programs in machine learning, artificial intelligence, data science, data engineering, cloud and database management, etc. For example, begin with a degree and courses at Kwame Nkrumah University of Science and Technology's Responsible AI Laboratory (KNUST-RAIL), African Institute for Mathematical Sciences (AIMS), Academic City, Ashesi University, University of Ghana, Academic City University College. ● The database shall also include resources available to such programmes (e.g. teachers, hardware). Additionally, the database shall take stock of specific policies and clauses in related policies that have linkages to these programmes. ● Based on the annual AI skills gap assessment, plan the rollout of additional modules, courses or degree programs in AI to be integrated into relevant subjects (e.g. computer science, statistics, mathematics, physics, biology). ● With tertiary education institutions, develop a plan to attract lecturers and research programs in AI. Build upon existing institutions attracting foreign experts such as AIMS or the first Master Sponsored Research Agreements in Africa between Google with KNUST and AIMS to enable research and leadership-sponsored programs developing young tech talent in Africa.	Ministry of Education, Ghana Tertiary Education Council	2023
	AI teacher training & upskilling	**4. Promote training courses for teachers** ● Work with Ghana Education Services (GES) ICT coordinators to train teachers. Consider existing programs such as the Smart Africa Digital Academy (SADA) and AIMS' online hybrid course for teachers in mathematics.	MoCD with Ministry of Education, Ghana Education Services, Ghana Tertiary Education Council, SADA, AIMS	2023

Pillar 2. Empower youth for jobs of the future

Outcome	Recommendation	Activity	Actor(s)	Year
Equip Ghana's youth to participate in the global AI and digital economy, raising employment and future-proofing jobs for the future	Remote AI job opportunities	**5. Facilitate remote jobs or internships in AI** • Enable local students or professionals to build competitive skills while contributing to Ghana's AI community through internships, on-the-job training, hackathons, hubs and incubator engagements. While job opportunities in AI are currently limited, locally based practitioners can gain employment and skills while contributing to community building in Ghana (**Pillar 5)** and local projects or companies at a later stage. Internships are an important part of training to develop practical skills. • Review programs which train youth and place them in local and international jobs (e.g. AmaliTech, Blossom Academy). • Incubation and innovation centres in the universities to support talented youth with start-ups and remote jobs. • Leverage Ghanaian diplomatic missions to facilitate and highlight AI remote jobs for youth in Ghana. • Expand the TVET voucher programme to include dedicated modules for digital skills of vocational trainees.	Responsible AI Office, universities, AI training providers	2024
	Tax incentives for youth in AI	**6. Develop tax incentives for youth in AI start-ups to promote employment** • Review the gaps in existing tax programmes for business and develop a new framework for incentivising youth entrepreneurship in the digital economy with an additional dispensation for AI start-ups. • GRA may engage beneficiaries of tax benefits to solve specified revenue mobilisation challenges.	MoCD, Ministry For Business Development, Ministry of Finance, Ghana Revenue Authority	2024

	AI Fellowships	**7. Develop AI Fellowship programs** • Design and run programmes to support applied and practical AI skills development in internships and projects in the public and private sectors. • These programmes should be housed in the various regional ICT centres or hubs (**Pillar 5),** including ecosystems outside of Accra. Develop KPIs and metrics to track the number of participants and job outcomes. • Coordinate with the Girls-in-ICT annual initiative by the MOCD for the inclusion of women in AI. • Target projects addressing specific problems in Ghana, such as projects with the Bank of Ghana's sandbox program to test innovative ideas. Include projects in rural areas to build inclusion.	Responsible AI Office, Accra Digital Centre, MoCD, Youth Employment Agency	2024
	Continuous training & short courses in AI	**8. Support continuous training and short courses for students and professionals to enter the AI field** • Provide financial grants and tax incentives or share program information with the AI community for training **(Pillar 5).** • Learn from the TVET-KFW training model to facilitate AI training for youth. Begin with examples such as Blossom Academy, Ghana Tech Lab's National AI Training Programme or 3-week National Female Pre-Tech Training Programme, Developers in Vogue, and free courses such as Microsoft Open Education or Hacklab Foundation, which integrates training with hackathons. • Publicise courses across the AI value chain ranging from data science and machine learning to technical and vocational training for data collection and labelling, cloud services/database management, and cybersecurity.	Responsible AI Office	2024

Pillar 3. Deepen digital infrastructure & inclusion

Outcome	Recommendation	Activity	Actor(s)	Year
Accessible & inclusive digital infrastructure in Ghana	Implementation of existing digital development policies	**9. Review and identify gaps in the implementation of existing digital policies including development of national data centres** I.e. Ghana Integrated ICT for Accelerated Development Policy (ICT4AD), e-Transform Project, Ghana Digital Economy Policy, and Ghana Integrated Digital Transformation Blueprint, including a focus on rural areas to ensure inclusion. Harmonise and integrate existing policies into a comprehensive plan across agencies and institutions. In addition, prioritise improving the affordability and reliability of high-speed internet across Ghana and developing national data centres. • Deepen co-creation and private-public partnership in digital infrastructure funding, development, deployment and utilisation, including to support national data centres. • Design a policy bridging framework across agencies to ensure that policies are responsive to the broader national development agenda, serving the needs of the people in a holistic manner, synergizing and ensuring non-duplication to optimise the use of budgets and resources. A policy bridging framework is the set of tools, models, governance approaches and protocols that different policies have to subscribe to ensure policy synergies, visibility and resource optimisation across sectors and agencies.	MoCD, Ghana Chamber of Telecommunications, AITI-KACE	2023

Competitive AI start-ups with access to world-class high-performance compute capacity	Plan for affordable access to world-class cloud computing	**10. Initiate mutual partnerships engagement with world-class cloud computing providers for affordable access for AI start-ups in Ghana** • Lead discussions with world-class cloud computing providers (e.g. NVIDIA, Google Cloud, Microsoft Azure, Amazon Web Services) to provide credits and subsidies for AI or digital start-ups across Ghana, enabling start-ups to overcome barriers in affordability and cost to access competitive cloud computing. Build upon frameworks from existing examples such as NVIDIA's offer to start-ups (NVIDIA Inception Premier Members) or Google's Black Founders Fund, or research partnerships with universities. • Explore incentive opportunities to attract local entrepreneurs and investors to develop local cloud computing infrastructure.	MoCD, Google, NVIDIA, and other cloud service providers.	2024
Robust AI start-up ecosystem	Coordinate and facilitate viable innovation and AI markets	**11. Orchestrate market dynamics that incentivise entrepreneurs to start enterprises that focus on AI products and services** • The government, through its ICT-oriented agencies, should work together to initiate strong market-led policy initiatives that: i. Clarify market conduct issues ii. Ease market entry iii. Establish enabling permissible segments to grow local AI enterprises	MOCD, NITA, NCA, DPC, GIFEC, Ghana Enterprise Agency, Chamber of Technology, Ghana Chamber of Telecommunications	2023

Pillar 4. Facilitate data access & governance

Outcome	Recommendation	Activity	Actor(s)	Year
Regulatory clarity and compliance in the AI & digital ecosystems to promote innovation and uphold privacy, security, and ethics	Implementation of data sharing & governance policies	**12. Disseminate and drive enforcement of existing data sharing & governance policies** Review and complete implementation of existing policies in data protection and cybersecurity, e.g. National Data Sharing Policy (NDSP); Data Protection Act, 2012 (Act 843); Right to Information Act 2019 Act 843; Cybersecurity Act 2020; Cyber Security Policy & Strategy 2015; Digital Financial Services (DFS) Policy; Health Sector ICT Policy and Strategy 2005, Electronic Transaction Act • Ensure industry-wide and cross-sectoral engagement and education to ensure uniformity • Create an advocacy and dissemination plan to educate, drive awareness and deepen the utilisation of these policies.	MoCD, DPC, Cyber Security Authority	2023
	Regulatory clarity for data sharing in PPPs in AI	**13. Clarify data privacy and data sharing agreements and regulations for partnerships** Build trust and transparency through national data sharing agreements, which would be championed and supervised by the DPC for all public & private institutions. This enables data holders to share data with AI project partners and start-ups across sectors, including public and private sectors, telcos and start-ups in PPPs.	MoCD, DPC, Cyber Security Authority	2023
Trustworthy, safe, secure and ethical AI applications in Ghana	AI Ethical Guidelines and tools for AI developers	**14. Disseminate guidance on trustworthy, safe, secure and ethical AI practices to AI developers and adopters** • Based on existing work at DPC on the ethical use of AI, equip AI practitioners in the private sector and government with guidance about international best practices in data governance. Leverage AI community networks **(Pillar 5)** to disseminate guidance. • Build upon work by UN Global Pulse with DPC to pave the way towards AI Ethical Guidelines in Ghana. Review and disseminate international guidelines such as OECD AI Principles and OECD.AI's Tools for Implementing Trustworthy AI or UNESCO Recommendation on the	DPC, NITA, Cyber Security Authority	2023

		Ethics of Artificial Intelligence. Share free self-assessment tools for AI developers like the EU AI Trust Label, Denmark's D-SEAL, Singapore's Implementation and Self-Assessment Guide for Organisations (ISAGO)		
Ghana contributing to and learning from leading international AI policies & practices	Participation in leading platforms shaping the responsible adoption of AI regionally and globally	**15. Apply to international and regional AI governance platforms** E.g. OECD Working Party on Artificial Intelligence Governance (AIGO), Global Partnership on AI (GPAI), UNESCO, ITU, Smart Africa, and African Union. Ghana would participate and perspective and learn from emerging best practices and national AI strategies for responsible AI.	Responsible AI Office	2024
Greater availability and accessibility of AI-ready data from the public and private sectors fueling Ghana's AI ecosystem	The rollout of Open Data initiatives, exchanges and APIs, Community-centric data exchanges and repositories	**16. Rollout of the Ghana Open Data Initiative (GODI), the Ghana Data Exchange Hub and data repositories** • Prioritise programs to share updated government data with the public or AI developers via APIs (data.gov.gh). Provide data collectors with guidelines and principles for collecting, storing and sharing data in both public and private sectors to be machine-readable and AI-ready. Ensure the data is cross-sectoral and not siloed. • Review case for data marketplaces in *Community-centric data exchanges for African Nations and the Continent: Roadmap for Ghana* (2022) by UN Global Pulse. • Work with international partners (e.g. Smart Africa, GIZ FAIR Forward, Mozilla), universities (e.g. KNUST Responsible AI Laboratory), and existing data labelling and collection initiatives such as Wiki in Africa or Ghana NLP to promote local and Africa-relevant data repositories. • Digital data programs should be implemented in concert with cybersecurity precautions and infrastructure for APIs. • Develop and implement incentive models that will stimulate data sharing from key institutions, agencies and demographics.	MoCD, NITA, Cyber Security Authority	2024

Pillar 5. Coordinate a robust AI community ecosystem

Outcome	Recommendation	Activity	Actor(s)	Year
A collaborative and coordinated AI community that accelerates the growth of AI in Ghana	Mapping & convening Ghana's AI community	**17. Build & convene an online and in-person AI community** • Task the Responsible AI office to build a live online repository of personnel, programmes and resources of existing AI communities in Ghana, such as the Artificial Intelligence Association of Ghana, Ghana NLP, Google Developers, Python Ladies in Accra, Deep Learning Indaba, Ghana Tech Lab, including its Africa AI Accelerator Program, Hacklab Foundation, Tony Blair Institute's Ghana AI Policy Network, and stakeholders participating in the National AI Strategy consultation process. Ensure inclusion of communities dedicated to women and other underrepresented groups. • Leverage these communities to expand the list to include start-ups, university research centres and programs (e.g. KNUST's partnership with Google on AI in agriculture), and students and professionals involved in AI. In addition, engage the Ghanaian professional diaspora working in international technology companies. • Using this list, convene an online community and an initial in-person meet-up, followed by a sequence of continuous engagements. The meet-ups can revolve around the occasion of a conference, project presentations, or a hackathon for a challenge in Ghana presented by the public sector that can pave the way for a PPP project. For example, launch a series of quarterly AI meet-ups for AI practitioners to present their activities or tackle shared problems based on the City.AI model. • Coordinate with MESTI for their envisioned knowledge-sharing platform to provide AI innovators with a collaborative environment and support tools.	Responsible AI Office MESTI	2023
	AI Hub in Ghana	**18. Expand and establish complementary physical or virtual AI innovation hubs across the country, especially in marginalised communities, to promote collaborations and knowledge sharing** • Consider model examples such as Tunisia's AI Hub at The Dot. Begin from existing hubs, such as (but not limited to) iSpace, Impact Hub, Kumasi Hive, hapaSpace in Kumasi, the HOPin	Responsible AI Office	2024

		Academy, iCode in Takoradi and Ho Node in the Volta Region, corporate office such as Google, or a virtual platform with events revolving around various hubs. ● Expand the capacity and presence of Accra Digital Centre across the various regions in Ghana, situating them to leverage the communities' unique strengths and opportunities. ● Liaise with District Assemblies to integrate AI Hubs with already established Community ICT Centres. ● Run community skills development and capacity building programmes in rural and community schools to drive awareness and deepen their digital-assertiveness.		

Pillar 6. Accelerate AI adoption across sectors

Outcome	Recommendation	Activity	Actor(s)	Year
Private sector AI adoption resulting in inclusion, productivity and efficiency gains across sectors	5 Key AI Pilot Projects to Showcase	**19. Spark investment into AI adoption with 5 AI pilot projects from across key sectors** • Catalyse investment into AI adoption by supporting the launch and showcasing the success of 5 AI pilot projects from key sectors: healthcare, transportation, agriculture, financial services, public administration and environment (See Appendix 1 - Booklet of AI Use Cases). Facilitate PPPs or collaborate with public and private sector entities and universities on projects to ensure synergies in R&D, funding, data, logistics, and scalability. • Coordinate with MESTI's Ghana Innovation and Research Commercialization Center (GIRC), CSIR-INST, and Strategic Technology Centers • Involve a selection outside of Accra for the inclusion of diverse communities. • In reference to Singapore's AI Strategy (2022), consider international collaborations with multinational researchers, businesses or governments to promote investment and knowledge sharing.	Responsible AI Office, MoCD, MESTI, sectoral ministries, Bank of Ghana, international development organisations, multinational technology companies	2024
	Copyright, IP and patent law	**20. Review and clarify laws for copyright, patents and intellectual property** Encourage investment into research and development at start-ups and companies by supporting intellectual property. Engage a broad IP community in Ghana, including the registrar of companies, to protect the property rights of innovators.	Various stakeholders in the IP community, IP and Patents Unit at Registrar General's Department at Ministry of Justice & Attorney General's Department	2023
	Incentives to support AI start-ups and R&D	**21. Implement incentives for AI start-ups, e.g. tax breaks for research & development or employment** Refer to any existing policies (e.g. Ghana Digital Economy Policy, Ghana Integrated Digital Transformation Blueprint, Digital Financial Services Policy, Ministry of Environment, Science, Technology and Innovation (MESTI) Innovation Policy, Health Sector ICT Policy and Strategy 2005, Ghana Health Service Patients' Charter 2002.	MoCD, MESTI, MoF, MoH, Accra Digital Centre	2023

Pillar 7. Invest in Applied AI Research

Outcome	Recommendation	Activity	Actor(s)	Year
Continuous improvement of AI implementations and value creation from new AI opportunities	A climate-smart Agriculture and Forestry Research Initiative	**22. Establish a Special Research Initiative to delve into climate-smart agriculture and forestry** To develop viable responsive solutions, the Initiative's goals include: • Improve productivity and commercial returns of farmers • Ensure Ghana contributes to the preservation of the environment and global sustainability goals in a context-responsive and measurable manner • Create strategies to sensitise key players who would benefit from research initiatives focusing on this domain • Fostering of Partnerships among R&D departments of institutions and startups to generate new ideas and develop new solutions, as well as work together to bring funding to solve challenges	MESTI CSIR-Institute for Scientific and Technological Information (CSIR-INSTI), universities	2025
	A Natural Language Processing Centre of Excellence	**23. Establish a Natural Language Processing (NLP) Centre of Excellence (CoE)** The CoE's goals include: • Expand Ghanaian language dictionary e.g. yearly addition of new words to the existing lexicon • Bridge gaps in communication for the general public including traders • Develop translating chips using AI to easily translate English text and other used foreign language text and audio into Ghanaian languages • Build legal tech that explores NLP to offer legal advice in Ghanaian languages ○ AITI-KACE is working on AI Projects in this regard at their Sunyani Campus • Coordinate with existing NLP expertise in Ghana, including Ghana NLP and university (E.g. KNUST) and industry actors (e.g. Google)	Institute of Languages (GIL), AITI-KACE, MESTI, MoCD, Ghana	2025

	A National Deep Science Institute	**24. Develop a framework for the establishment of a National Deep Science Institute** The Institute would pursue research in deep tech, cognitive tech, and leverage ML & AI to tackle critical societal issues as well as uncover breakthroughs for critical sectors of Ghana's economy: The focus should be on: ● Using AI to tackle and churn context-relevant inventions, new tools, learned models and insights to boost Ghana's sectors (e.g. health) and industry. ● Develop a strong data core for ML that other sectors, businesses and stakeholders can leverage. ● Develop capabilities in general purpose AI in a broad range of cognitive domains, such as learning, language, perception, reasoning, creativity, and planning. ● Develop capabilities in context-relevant human-AI collaboration to augment collaboration and shared abilities between humans and AI to boost outcomes and productivity of human labour.	MESTI, MoCD, Ghana Tertiary Education Council, Academia, e.g. KNUST Responsible AI Laboratory (RAIL)	2025

Pillar 8: Promote AI Adoption in Public Sector

Outcome	Recommendation	Activity	Actor(s)	Year
Leverage the public sector as a key demand driver for AI companies and start-ups.	Public procurement processes redesigned to include AI start-ups	**25. Develop a program that increases access for digital & AI-focused start-ups to public procurement processes** • Leverage the public sector to support demand and opportunities for innovative start-ups. Startup-friendly tenders/bids to be made available to support innovators in AI adoption. • Facilitate partnerships between start-ups and larger companies to collaborate in public procurement bids; Establish a framework for bidding consortia to involve start-ups. Alternatively, develop a programme or regulatory sandbox to ease the minimum requirements for start-ups to apply to projects and enable trial and error. Refer to Tony Blair Institute for Global Change's 'AI Procurement' recommendations in its AI Toolkit. **26. Evolve public sector mindset to view algorithms as IP and work with vendors & start-ups to co-create IP in AI** • Review contracting frameworks and establish a new contractual regime that motivates public sector investment in algorithms to co-create IPs.	MOCD, Accra Digital Centre, Public Procurement Authority, Ministry of Business Development	2023
AI transformation projects in the public sector	Civil servant AI capacity building program and digital culture mainstreaming	**27. Establish a program to train civil & public servants to design, lead and implement AI projects in public services** Build on examples such as Smart Africa Digital Academy (SADA)'s free 13-hour online course 'Artificial Intelligence for Policymakers', UNESCO's 'Digital Transformation & AI Competency Framework for Civil Servants,' the Tony Blair Institute's 'Harnessing Responsible AI Toolkit,' or GIZ and Human Sciences Research Council's 'Handbook for Implementing a Capacity Building Programme for Policy Makers on AI.' **28. Incentivise an AI culture by creating a reward system to encourage service delivery excellence utilising AI** Individuals can be rewarded (compensation, promotion, awards, recognition) for their role in utilising AI and ML to enhance public sector services delivery while exemplifying a positive AI and innovation culture.	NITA, AITI-KACE, Ghana Civil Service, Public Services Commission, National Labour Commission	2024

	Use of AI to guide Policy Planning, Programmes, Adoption and KPI Monitoring and Evaluation in the Public Sector	**29. Develop a comprehensive public administration data dashboard/interface to provide data analytics for policy planning, programme mix, resource allocation, monitoring and evaluation** Design and deploy a cross-agency Policy Data Reference Bureau (PDRB) for data gathering, sharing, analytics & visualisations for smart decision making.	Public Services Department, Office of the President, NITA, Private Sector	2025
	Transform public sector operational workflows and integrate AI in core public service functions	**30. Initiate a programme to identify key public service AI use-cases** ● Review opportunities in Appendix 1 - Booklet of AI Use Cases. ● For example, virtual agents for citizen services such as filing for taxes, requesting and renewing driver's licences and identification. AI to transform public infrastructure maintenance by using unstructured video data from public transport vehicles such as buses to detect potholes and generate a schedule and tracking model for repairs. **31. Develop a workflow and operational framework for public sector work for agility & data-driven decision making** ● Set up a public sector workflow transformation committee to review existing workflow and develop an operational architecture that aligns with the Enterprise Architecture led by NITA and integrates seamlessly with the Common National Digital Architecture. ● Encourage positions for data scientists in key sectors to support data-driven decision-making in the public sector.	Ministry of Local Government and Rural Development, Public Works Department, NITA	2023

Appendix 1 - Booklet of AI Use Cases

AI in Healthcare in Ghana
AI in Smart Electricity Grid in Ghana
AI in Environment & Circular Economy in Ghana
- Air Quality Monitoring
- Recycling
- Smart water management

AI in Transportation in Ghana
- Urban Traffic Management System
- Smart Vehicle Fleet Management System

AI in Agriculture in Ghana
- Increasing Crop Yields
- Soil Management
- Farm Management
- Detecting Food Fraud

Land & Natural Resources in Ghana
- Simulation Modelling of Landscape and Settlement Distribution
- Land Use and Development
- Wildlife and Forest Conservation

AI in Financial Services in Ghana
- Business-to-business (B2B)
- Business-to-consumer (B2C)
- Consumer-to-consumer (C2C)

AI in Healthcare in Ghana

AI can be widely used in healthcare by addressing challenges and leveraging digital data to improve and expand access to quality healthcare. Use cases vary across the so-called “4P Medicine”: Personal, Preventive, Participative and Predictive.[13] Personalised and precision medicine, more accurate and faster diagnostics, and mobile health applications can also increase millions' access to quality medical care. AI applications in healthcare can overcome limitations in government resources, augment human expertise and improve doctors' productivity, health outcomes, and efficiency in services. For example, AI is used in diagnostics for medical imaging, genomics and predictive medicine, therapy in tools for biotech and robot surgeons, and managing health systems and long-term care.[14] Efficiencies can support cost reductions and increase inclusion by extending clinician services into remote areas at a lower cost. In healthcare, lives can be helped and harmed - necessitating careful assessment of AI system lifecycles and risks.

Across Ghana, there are many opportunities and high interest to utilise AI to improve healthcare.[15] For example, the National Health Insurance Scheme (NHIS)’ claims management system can be improved by matching prescriptions with costs of medications and healthcare. Current examples of AI applications in Ghana include:

- AI to predict prescription refills by mPharma[16]
- AI for automated diagnostics, forecasts and prognostics by MinoHealth[17].
- AI for transporting medical equipment to the rural parts of Ghana using drones by Zipline[18].
- AI in the provision of patients with easy access to their digital health records by Redbird[19]
- AI for remote patient monitoring to effectively assist the deficit in providing patient ratios, maternal mortality rates[20]
- Ghana NLP is leveraging hospital records to predict infant mortality for malaria to support triaging emergency cases.
- KNUST Responsible Artificial Intelligence Laboratory (RAIL) is working with partners to develop language translation tools for doctors in remote areas in Ghana.

The global artificial intelligence in the healthcare market is estimated to generate USD 6.9 billion

[13] Lannquist, Y, (2021), “AI in healthcare in Africa,” The Future Society, https://thefuturesociety.org/wp-content/uploads/2022/02/AI-in-Healthcare-in-Africa-TFS-for-Mo-Ibrahim-Foundation-Forum-Report_vf.pdf.
[14] Ezratty, O. (2018), *Les usages de l’intelligence artificielle,* Edition 2018, Online, https://www.oezratty.net/wordpress/2018/usages-intelligence-artificielle-2018/.
[15] Expert interviews; https://www.trade.gov/country-commercial-guides/ghana-healthcare; https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf
[16] https://mpharma.com/
[17] https://www.minohealth.org/
[18] https://www.flyzipline.com/
[19] https://redbird.co/
[20] https://swisscognitive.ch/2022/03/29/perceptions-ghanaian-healthcare-workers-have-about-ai/

in 2021 and reach USD 67.4 billion by 2027.[21]

Key actors in Ghana include: the Ministry of Health, Ghana Health Service, pharmacies, hospitals, startups, e.g. mPharma, MinoHealth AI Labs, Zipline, Redbird and academic and corporate applied AI research labs.

AI in Smart Electricity Grid in Ghana

AI can optimise power delivery in the electrical grid[22]. Examples include:

- Prediction of faults in the grid to prevent the occurrence of the fault and save electrical equipment
- Optimization of power routes to reduce power line losses and save money on electricity generation.
- Maintenance scheduling optimization across all phases of electricity delivery, including generation, transmission, and distribution.
- Prediction of demand in the grid to avoid outages when demand exceeds supply and lower costs in electricity production since more efficient and cost-effective sources of electricity can be sourced and emergency generation would be reduced.

Besides improving the electricity system, the market opportunity is $817 million per year (based on calculated loss in revenue in power outages from 2015 estimated at $55.8 million per month and adjusted for inflation). Key players include the Electricity Company of Ghana (ECG), the Ghana Grid Company (GridCo), the Volta River Authority (VRA), and artificial intelligence startups.

AI in Environment & Circular Economy in Ghana

Smart Africa's *Blueprint: Artificial Intelligence for Africa* report presents various examples of AI applications for climate action.[23] Similarly, the Global Partnership on AI (GPAI) has identified numerous applications of AI to help combat climate change and support the environment.[24] Illustrated examples for Ghana include AI applied to monitor air quality, support renewable energy, manage recycling and water. Key actors in Ghana include the Ministry of Environment,

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[21] Artificial intelligence in healthcare, 2021, Markets and Markets, https://www.marketsandmarkets.com/Market-Reports/artificial-intelligence-healthcare-market-54679303.html

[22] Jian Jiao 2020 Iop Conf. Ser.: Earth Environ. Sci. 510 022012, Https://Iopscience.Iop.Org/Article/10.1088/1755-1315/510/2/022012/Pdf; SAP Insights, "The smart grid: How AI is powering today's energy technologies, https://www.sap.com/insights/smart-grid-ai-in-energy-technologies.html.

[23] Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.

[24] Global Partnership on AI, *Climate Change and AI,* https://www.gpai.ai/projects/climate-change-and-ai.pdf

Science, Technology & Innovation (MESTI), the Ministry of Energy, Ghana Water Company Limited (GWCL), and AI startups.

Air Quality Monitoring

Air quality monitoring stations and devices installed with AI capabilities could help renewable energy companies monitor how their operations are affecting the environment and how they can take action.

Recycling

An aerial view of Ghana's beaches, markets, lorry parks and stations reveals the amount of plastic waste generated and poor reuse and recycle culture. An exploration of robotics devices that can sort waste into plastics or recyclable material and biodegradable could help gather all recyclable waste to be prepared for recycling. Drone technology could be used to survey areas that have a high concentration of human activities during the day, e.g. markets, lorry stations, etc., to monitor the rate at which plastic waste is generated, where to provide waste separation containers, and to provide recycling companies with the data collected for action to be taken.

For example, Environment360 is a Ghanaian plastic waste management company that could take advantage of AI solutions to obtain insights on points where plastic waste is heavily generated. There is also the opportunity to gather data on the rate of plastic waste accumulation that could be informative to the government to aid with programmes to reduce waste in the country.

Smart water management

AI can be a great tool for better management of water distribution in Ghana. Currently, much of the water that leaves treatment plants runs on the ground due to burst pipes, leakages and other reasons. AI can be leveraged with the Internet of Things (IoT) hardware to detect leakages and automate the closing of various sections of the distribution system to reduce the loss of treated water. If AI is used in conjunction with supervisory control and data acquisition (SCADA), this will lead to real-time analysis of the water distribution network in Ghana for leakages and other important information like water pressure. AI can also be used to predict bursts and leakages through the analysis of various data, such as the age of pipes and storage units, water pressure, and frequency of maintenance. Lastly, AI can also be leveraged to analyse usage statistics of various neighbourhoods to predict and better schedule maintenance of various system sections.[25]

The global Smart Water Management market is expected to grow from USD 13.8 billion in 2021 to USD 22.4 billion by 2026, at a Compound Annual Growth Rate (CAGR) of 10.1% during the

[25]Jenny, H., Wang, Y., Alonso E.G., Minguez R. 2020. Using artificial intelligence for smart water management systems, ADB Briefs. DOI: http://dx.doi.org/10.22617/BRF200191-2

forecast period.[26]

AI in Transportation in Ghana

The transport market is vast with road, air, rail, river and sea transport. AI applications in the realm of transportation are varied. Some applications rely on optimisation theory, for example, for route planning. Transport apps can make it easier for commuters to plan their journeys. AI applications are also used for yield and pricing management by, for example, airlines[27]. Other applications rely on computer vision, for example, for autonomous driving. Autonomous vehicles (AVs) are cars that "sense" their environment and move within it with little or no human input[28]. The operating environment of AVs is highly dynamic and uncertain, immediate response times are necessary, and accuracy must be extremely high to prevent accidents. Key actors in Ghana include the Ministry of Transport, Ghana Roads and Highways Authority, Motor Traffic and Transport Directorate of the Ghana Police Service, AI startups (e.g. Ayalolo), Mapping NGOs such as OpenStreetMap Ghana that provide maps data to global maps providers such as Google/Apple Maps.[29]

The next steps include:

1. Research
   The use cases outlined encompass various requirements and require participation and support from various government and private actors. Feasibility studies can assess the revenue potential of the use cases and the impact on the urban population versus the rural population.

2. Infrastructure investment
   Most of the investment required to actualize these use cases is in software engineering. For example, the transponders mentioned in the examples could be an app on a smartphone with a high-fidelity data connection.

Urban Traffic Management System

There are applications for AI in monitoring, maintaining and optimising the flow of traffic for smart urban cities. In urban traffic management systems, AI can predict and optimise traffic

[26] Smart water management market, 2021, markets and markets, https://www.marketsandmarkets.com/Market-Reports/smart-water-management-market-1265.html; Meenu EG, 2021, The promise of artificial intelligence in water management, Analytics Insight https://www.analyticsinsight.net/the-promise-of-artificial-intelligence-in-water-management/.
[27] Ezratty, O. (2018), *Les usages de l'intelligence artificielle,* Edition 2018, Online, https://www.oezratty.net/wordpress/2018/usages-intelligence-artificielle-2018/.
[28] Taeihagh, A., Hazel Si Min, L. (2019), *Governing autonomous vehicles: emerging responses for safety, liability, privacy, cybersecurity, and industry risks*, Transport Reviews, **39** (1): 103–128. arXiv:1807.05720. doi:10.1080/01441647.2018.1494640. ISSN 0144-1647.
[29] "Home | OpenStreetMap Ghana." OpenStreetMap Ghana, https://osmghana.org/. Accessed 3 Sept. 2022.

flows to reduce traffic and, consequently, reduce travel time, pollution from idle cars, and congestion. AI can be used to predict the optimal phasing arrangements and the optimal duration for each phase at traffic intersections. Computer vision systems in traffic cameras can monitor traffic flow and detect rules violation. AI can also be used for traffic coordination in emergency cases like ambulances and motorcades or for road toll monitoring and collection.[30]

Smart Vehicle Fleet Management System

Vehicle fleet management refers to the set of activities to maximise the lifetime value of a fleet of automobiles. Corporations with large fleets of automobiles, such as trucking and airline companies, employ such techniques extensively to maximise profits by maximising asset utilisation while simultaneously minimising costs. An often overlooked factor in vehicle fleet management is that companies track their fleet in real-time. This generates a vast amount of real-time probe data ripe for exploitation for various other optimization objectives using AI.

For example, consider a scenario where all public buses in Accra are fitted with a smart transponder that transmits the vehicle's location every 2 seconds. Once the probe data is collected in a central location and transformed into a standard format such as Apache Parquet[31], AI can be used to enable a whole range of interesting use cases.

Route planning is a classical optimization problem that can be solved using numerous direct analytical techniques[32]. AI models are very useful in such scenarios involving massive datasets. Techniques such as deep reinforcement learning (RL)[33] can be employed to train a model to learn patterns from historical data to predict - i.e. infer - future movements in real-time. In addition, AI can help predict the estimated time of arrival (ETA) to unlock the basics of a mapping platform specific to Ghana and the travel preferences of its population. RL refers to the branch of AI machine learning where the model training is neither supervised nor unsupervised[34]. Rather, the AI model generates different what-if scenarios and measures the performance of its predictions based on historical data. The training phase is very time- and compute-intensive, so it must be performed offline. However, once a model is trained on sufficient training data - for example, probe data over a single year would be sufficient for accurate predictions in this use case - it can plan routes in real-time.

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[30] O.I. Olayode, L.K. Tartibu, M.O. Okwu, Application of Artificial Intelligence in Traffic Control System of Non-autonomous Vehicles at Signalized Road Intersection., Procedia CIRP, Volume 91, 2020, Pages 194-200, ISSN 2212-8271, https://doi.org/10.1016/j.procir.2020.02.167; Mazur, S., 2020, Smart traffic management: optimizing your city's infrastructure spend, https://www.digi.com/blog/post/smart-traffic-management-optimizing-spend.

[31] "Apache Parquet." Apache Parquet, https://parquet.apache.org/. Accessed 3 Sept. 2022.

[32] M. A. P. Muniandy, L. K. Mee and L. K. Ooi, "Efficient route planning for travelling salesman problem," 2014 IEEE Conference on Open Systems (ICOS), 2014, pp. 24-29, doi: 10.1109/ICOS.2014.7042404.

[33] Bello, Irwan, et al. "Neural combinatorial optimization with reinforcement learning." arXiv preprint arXiv:1611.09940 (2016).

[34] Osiński, Błażej. "What Is Reinforcement Learning? The Complete Guide - Deepsense.Ai." Deepsense.Ai, Błażej Osiński, 5 July 2018, https://deepsense.ai/what-is-reinforcement-learning-the-complete-guide/.

AI can be applied in monitoring, maintaining and managing fleets of public transport buses in the cities and around the country. The Government of Ghana currently has transportation services - Ayalolo and metro mass transit. With the proliferation of mobile and smartphones among most Ghanaians, AI mobile apps for fleet management could be used to schedule bus times for various pick-up locations. During peak and low times, this same app can meet the changing demands of buses at a particular station or pick-up point. It can provide information on the location of all public buses and the state of these buses in terms of maintenance and also track the performance of drivers and vehicles. The AI fleet app should be able to provide information on trips to log issues and other information for reporting on the performance of the public transportation services. The AI-enabled app solution could be extended to the private sector to taxi cab and "trotro" bus owners who may want to streamline their transportation services.

Consider a scenario where all public buses in Accra are fitted with smart transponders that transmit not only the vehicle's location every 2 seconds but also the total occupancy of the vehicle at that point in time. RL can be employed not just for route planning and ETA prediction but also for capacity estimation. This would allow local developers in Ghana to develop travel applications where users can book an end-to-end trip comprising different modes of transportation such as bicycles, buses, and taxis. Although existing ridesharing services - such as Uber, Bolt, Swift-Wheels, and others[35] - already operate in this space, their services are limited to drivers signing up to relay passengers using their private vehicles. Providing visibility into the capacity and route planning for public transportation services would allow such apps to offer riders options involving public transportation. This could also start a virtuous cycle of charging these apps for their API calls and reinvesting those profits into making public transport safer and more reliable for the consumer.

AI in Agriculture in Ghana

According to NASA climate simulations, crop yields in Ghana are predicted to decrease due to climate change over the next decades.[36] Meanwhile, Ghana's yield for various crops has chronically fallen below its potential [15] [16] [37]. In addition to making up a large portion of the

[35] Ofori, Bright. "Ride Hailing Apps In Ghana 2022." ICT Catalogue, https://facebook.com/ictcat, 16 July 2022, https://ictcatalogue.com/ride-hailing-apps-in-ghana/.
[36] Jägermeyr, J., Müller, C., Ruane, A.C. *et al.* Climate impacts on global agriculture emerge earlier in new generation of climate and crop models. *Nat Food* 2, 873–885 (2021). https://doi.org/10.1038/s43016-021-00400-y;
NASA, 2021, "Global Climate Change Impact on Crops Expected Within 10 Years, NASA Study Finds," https://www.nasa.gov/feature/esnt/2021/global-climate-change-impact-on-crops-expected-within-10-years-nasa-study-finds
[37] *Ghana - Global yield gap atlas*. (n.d.). Global Yield Gap Atlas. Retrieved August 28, 2022, from https://www.yieldgap.org/Ghana

country's GDP[38], agriculture is responsible for earning approximately 10% of Ghana's export receipts[15] [39].

The market opportunity for AI in agriculture is tremendous. For example, Ghana earned 3 billion USD yearly from its agricultural exports from 2008 to 2020[40]. Moreover, a conservative estimate of 10% for the improvement in crop yields due to AI delivers at an additional 300m USD per year. As a result, the global AI in Agriculture Market is expected to reach USD 3,984.5 Million by 2026 and to grow at a compound annual growth rate (CAGR) of 25.2% from 2019 to 2026.

There are many applications for AI in agriculture.[41] According to Smart Africa's *Blueprint: Artificial Intelligence for Africa* report, AI can play a role in the whole value chain, from financing creditworthy smallholder farmers to supporting production by analysing and predicting diseases and pests and promoting greater price control. The report points out that the lack of data could be addressed using nontraditional data like satellite imagery or phone data to analyse crops or weather data.[42] AI can also be used to improve supply chain logistics (including in fertilisers) and inventory and to prevent food waste. AI can also support detecting food fraud, such as the mixing of dyes with palm oil or inauthentic honey.

Key actors in Ghana include the Ministry of Food and Agriculture, Ministry of Environment, Science Technology and Innovation (MESTI), Universities and research institutions such as Kwame Nkrumah University of Science and Technology (KNUST) and the School of Agriculture at the University of Ghana, AI startups like Karagro AI and Farmerline, the Planting for Food and Jobs Initiative (PFAJ), Agricultural Development Bank (ADB).

The next steps include:

1. Research and domain studies
    a. Projects in this space will require coordination with a large number of stakeholders. Therefore, it is imperative to obtain empirical data about the feasibility of these projects to help guide discussions and decisions around prioritisation and funding. (Refer to Ghana's National AI Strategy Pillar 7: Invest in Applied AI Research).
2. Hardware investment
    a. Investments in network hardware will account for the largest proportion of investments in this space. This includes but is not limited to drones to obtain images and video of crop plantations, a variety of sensors to gather soil quality

[38] Anzola, F. (n.d.). *Ghana (GHA) Exports, Imports, and Trade Partners | OEC*. OEC - The Observatory of Economic Complexity. Retrieved August 28, 2022, from https://oec.world/en/profile/country/gha
[39] *Ghana*. (n.d.). United States Trade Representative. Retrieved August 28, 2022, from https://ustr.gov/countries-regions/africa/west-africa/ghana
[40] Statista. (2022, March 14). *Export of agricultural products in Ghana 2008–2020*. Retrieved August 28, 2022, from https://www.statista.com/statistics/1111140/export-of-agricultural-products-from-ghana/
[41] Faggella, D., 2020, AI in Agriculture - present applications and impact, https://emerj.com/ai-sector-overviews/ai-agriculture-present-applications-impact/ ;
[42] Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.

information, and internet infrastructure providing connectivity for periodic data uploads.

3. Capacity building
    a. Using AI will affect the existing processes and procedures. For example, once the AI model generates a signal, the farm employees will need to act on it. Training is crucial to ensuring that the feedback loop created by employing AI on existing farms is successful. Support from the local farming communities is also essential in this regard. The feedback loop must be accessible and user-friendly; otherwise local stakeholders will not buy into the idea, and adoption will lag.

Increasing Crop Yields

Crop yields are heavily dependent on a variety of factors, such as the amount of water, fertiliser, temperature, and pesticide. AI models can process signals from all of these variables in real-time to predict crop yields [43]. Furthermore, AI models can trigger alerts when readings are predicted to fall below or above pre-configured thresholds that signify the optimal amount for any given feature.

Computer vision techniques such as panoptic segmentation can be used to classify images of crops into healthy and unhealthy categories based on the details extracted from them. Panoptic segmentation is an ensemble machine learning method that employs semantic and instance segmentation on signals such as colour and shape to classify images. This can be an effective method to monitor the rate of growth and health of crops in different areas of a plantation. Furthermore, combined with other sensor data, image segmentation can be useful for yield mapping, which refers to a suite of techniques for predicting soil yield. Startups in Ghana like karaagro.com and farmerline co already provide relevant services in this sector.

Since AI heavily depends on data for its predictive models, data collection is crucial for increasing crop yields. In agriculture, drones can gather visual data - both video and static images - on crop plantations. Additionally, sensors can gather fine-grained soil measurements to ensure that crops receive the right amount of nutrients and water. Other sensors could collect data on the temperature to which crops are exposed. The AI techniques employed will differ according to the data the model uses for training.

Soil Management

The health of the soil used in farming is a major factor that impacts crop yield. AI can be used to monitor the health of the soil to make better decisions on soil nutrients, fertilisers, and the type of crops suitable for the type of soil condition. Data collected by soil health detective drones

[43] Cavallito, M. (2022, February 23). *Artificial intelligence can reduce fertilizer use, UK researchers say*. Re Soil Foundation. Retrieved August 28, 2022, from https://resoilfoundation.org/en/innovation-technology/artificial-intelligence-fertilizer/

could be analysed to inform how the health of the soil should be improved, nutrient deficiencies, the variety of crops that do well in the type of soil, and to plan for larger or leaner harvests. The health of the soil could also inform how farmers can plan for crops to meet the market's demands. Weather conditions data collected from a soil monitoring device can provide information on crops that will thrive during the year.

For example, a German-based tech start-up, PEAT, has developed an AI-based application called Plantix that identifies the nutrient deficiencies in soil, including plant pests and diseases. With this information, farmers can know which fertiliser could help improve harvest quality. Likewise, trace Genomics is an American AI-based company that provides analysis to monitor the health of crops and soil for farmers.

Farm Management

AI can improve the efficiency of farms where cash crops like cocoa, millet and others are grown in Ghana. AI can be used in the automation and optimization of the irrigation of large farms. Using drones equipped with computer vision can monitor fields and detect diseases on the leaves of the plants - enabling precision agriculture and targeted pesticides. This analysis can inform how many plants are diseased and how long they have been infected and allow for quick interventions to limit the spread of diseases and prevent the loss of whole fields.[44] The Kenyan smartphone application Eska allows farmers to return an automated AI-enabled analysis of potential diseases of plants through their phone cameras.

Detecting Food Fraud in Agriculture Supply Chain to Enhance Food Safety

Food fraud occurs when consumers are deceived about the quality and/or composition of the food they are purchasing. It is typically motivated by vendors' desire to gain an unfair advantage in markets. Mislabeling, adulteration, and ingredient substitution are pervasive forms of food fraud that affect people worldwide. AI can be used to verify the authenticity of food products and food additives in accordance with Codex Alimentarius standards. The Codex Alimentarius, also known as the "Food Code", is a collection of international standards, guidelines, and codes of conduct designed to protect consumer health and ensure fair trade practises in the food industry. The WTO Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures acknowledges Codex food safety standards as the international benchmark. When food producers and traders adhere to Codex standards, consumers can have confidence in the safety and quality of the products they purchase, and importers are assured that the products meet the specifications.

[44] Selvaraj, M.G., Vergara, A., Ruiz, H. *et al.* 2019. AI-powered banana diseases and pest detection. *Plant Methods* 15, 92. https://doi.org/10.1186/s13007-019-0475-z; Mohanty Sharada P., Hughes David P., Salathé Marcel. 2016. Using Deep Learning for Image-Based Plant Disease Detection, Frontiers in Plant Science, vol 7, https://www.frontiersin.org/articles/10.3389/fpls.2016.01419.

AI can be utilised to mainstream food safety standards and reduce the public health risks associated with food fraud. Specifically, AI can also detect errors and fraud in the last few steps of any food distribution chain, from factory to retailer. All parties can access real-time data on consumer feedback, buying trends, weather, factory or farm locations, harvest progress, and other metrics by farmers and suppliers. Using machine learning, anti-counterfeit tools can be used to detect fake products from genuine ones, such as the mixing of dyes with palm oil or inauthentic honey.

AI in Land & Natural Resources in Ghana

Predictive technologies enabled by AI can be beneficial to support land use and development, natural resources and conservation in Ghana. However, given the importance of this sector for the country and economy, it is important to mobilise partnerships among institutions and technology providers to improve outcomes.

Key actors in Ghana include the Land Use and Spatial Planning Authority (LUSPA), Ministry of Lands and Natural Resources (MLNR), Minerals Commission, Forestry Commission, Lands Commission, Centre for Remote Sensing and Geographic Information Services (CERGIS), mining companies, real estate development companies, AI startups, university research centres, Ghana Wildlife Society.

Simulation Modelling of Landscape and Settlement Distribution

AI can be used in modelling and predicting the changes in the landscape and settlements based on the unearthing of certain natural resource deposits in the country. Ghana still has many untapped natural resources that could aid the nation's development, most of which can be found in already inhabited areas. When a natural resource (e.g. gold deposit) is discovered, AI can be used in simulating and modelling the impacts of extraction on the landscape and settlements. Based on data from previous settlements in the region, AI can assist in planning settlements around natural resources and in predicting how already existing settlements would be affected by resource discovery. This should help the government agencies be more proactive in quickly addressing settlement concerns and utilising natural resource discoveries.[45] For example, The Predictive Analytics Lab at the University of Sussex has a working Simulation Modeling Tool that uses aerial photography data to classify land use.

Land Use and Development

AI can be used in planning land use and development. Due to climate change and changes in human needs, the environment is uncertain and changing dynamically - necessitating proper planning for current and future generations. In addition, coastal areas, including the capital city, will require urban planning, given the loss of land to the sea and sea water levels rising. AI is a

[45] Zheng, Minrui, Wenwu Tang, Akinwumi Ogundiran, and Jianxin Yang. 2020. "Spatial Simulation Modeling of Settlement Distribution Driven by Random Forest: Consideration of Landscape Visibility" *Sustainability* 12, no. 11: 4748. https://doi.org/10.3390/su12114748

powerful tool that can assist planners and developers in governing land use and infrastructure developments. AI can assist urban and rural planners in studying various scenarios and evaluating development options. It can also be used to monitor trends and detect anomalies. For example, the Urban Redevelopment Authority in Singapore deploys AI in urban and infrastructure decisions. Meanwhile, the Lands Department of Hong Kong is undertaking a project that leverages AI to plan urban development projects. Real-time, accurate land use maps produced from satellite images provide a more efficient way to understand the situation on-ground, compared to traditional physical site visits and laborious measurement approaches.

Wildlife and Forest Conservation

For the conservation of wildlife in our ecosystem, smart devices and cameras for detecting animal activities could be positioned strategically by the Wildlife Society of Ghana to monitor the populations and protect them from poachers, hunters and other harmful situations. For example, Panthera is an international NGO leveraging analysis of video and photos to track populations and catch poachers. Furthermore, drones can fly over wildlife reserves sending real-time images of species populations and activities to update the country's databases. Drones could also send information on injured, sick or any wildlife that could be in danger that needs assistance.

Using smart devices at strategic points in our forest reserves could help curb unlawful deforestation.[46] Satellite and aerial imagery could also be captured for updating the national forest reserve database periodically - helping to track which trees are in danger of extinction or unlawful felling. Furthermore, drones could be deployed over areas prone to bushfires during the dry seasons to monitor human activities that could spark flames. In the same way, drones could be deployed over land to send back real-time data on the extent of damage caused by fires and the locations. This data will provide information on the next line of action to take and equip authorities to be proactive in future occurrences.[47]

AI in Financial Services in Ghana

Several types of AI-enabled systems create value for financial services organisations. These may include customer service chatbots, algorithmic financial planning, recommender systems for personalised financial products, automated check verification, assessments for loan applications or insurance claims, or search and discovery for mortgage processes.[48] Fraud detection is also a classic application of machine learning, which uses past data about payers

[46] Abdenur, A., 2020, How can AI help curb deforestation in the Amazon?, IPI Global Observatory, https://theglobalobservatory.org/2020/11/how-can-artificial-intelligence-help-curb-deforestation-amazon/.
[47]World Economic Forum, 2022, How AI can help the world fight wildfires, https://www.weforum.org/agenda/2022/05/how-ai-can-help-the-world-fight-wildfires/.
[48] Ezratty, O. (2018), *Les usages de l'intelligence artificielle*, Edition 2018, Online, https://www.oezratty.net/wordpress/2018/usages-intelligence-artificielle-2018/.

and transactions to suspicious flag operations[49].

Key actors in Ghana include the Bank of Ghana, Ministry of Trade and Industry, National Information Technology Agency (NITA), Telecommunications chamber, private and public banks, insurance companies and leasing companies, and AI startups such as Nokwary AI and Mazzuma. In addition, existing pilot projects among AI startups, universities, and public institutions such as the Bank of Ghana are underway.

The financial services industry of Ghana includes companies engaged in lending activities - such as traditional banking and leasing - and insurance. AI solutions can be deployed broadly for direct business operations within each vertical or across regular business operations to help improve the customer experience, for example. The market opportunity for AI in the financial services industry falls into 2 main categories: direct business operations and support services. Overall, all verticals from both categories in the financial sector represent a total global addressable market of 3.88B USD in 2020, rising to 64.03B by 2030 [50]. In direct business operations, AI applications can be subdivided into further categories based on the business vertical they serve:

Business-to-business (B2B)

A major driver of AI adoption is to reduce risk. Mining massive amounts of data with the help of AI tools can enhance the Bank of Ghana's ability to combat money laundering, for example.

Business-to-consumer (B2C)

The major driver of AI adoption is to enhance the consumer experience. For example, AI adoption can significantly reduce fraudulent credit card transactions, thereby protecting consumer spending power and enhancing their confidence. Insurance companies, on the other hand, can benefit by using AI to analyse images of the damage for claims: computer vision techniques such as instance and semantic segmentation can be used for identifying which parts of the car were damaged; depth perception can then be employed to assess the extent of the damage. In addition, automating the assessment of the damage using AI would speed up the insurance claims process for the customer, resulting in higher customer satisfaction.

There is an exciting opportunity to address the needs of "unbanked" consumers in this vertical using AI. Credit scores have been a barrier to entry for those who do not transact routinely in the formal economy. AI can be used to establish "communities" that can vouch for people applying for micro-loans in the informal economy. This is similar to the model successfully adopted by Grameen Bank and BRAC to serve people with little or no access to credit via banks

[49] Ibid.
[50] *Business Wire*. (n.d.). Businesswire. Retrieved August 28, 2022, from https://www.businesswire.com/news/home/20220131005583/en/The-Global-AI-in-Banking-Market-Will-Grow-to-64.03-Billion-by-2030-at-a-CAGR-of-32.6-During-2021-2030---ResearchAndMarkets.com

[51] [52] [53]. However, the difference is that AI techniques allow lenders to scale massively with a fraction of the infrastructure footprint of NGOs like Grameen Bank and BRAC.

Consumer-to-consumer (C2C)

Using AI for calculating credit scores can unlock the peer-to-peer lending market by establishing a measure of customer trustworthiness. The consumer credit score would include purchase history, payment history, social standing, et cetera. All of these aspects of consumer spending behaviour, taken in aggregate generate petabytes of data which can be analysed using AI to identify trends and assign a score predicated on saving and spending habits.

The second category of services comprises mainly customer service activities like chatbots and customer helplines. The specific technologies that power these services are voice-to-text transcription and natural language processing (NLP). Ghana has good potential to develop such solutions in a local context, especially where language services are required.

Ghana has tremendous potential in all of these sectors. However, public-private partnerships (PPPs) are crucial for unlocking the latent value in the startup ecosystem. PPPs provide institutional support, financing of AI ventures, and access to a large customer base in government services.

In the near term, it is important to adapt procurement guidelines for soliciting tenders for government-backed projects to make it easier for AI startups to participate. The opportunities will require major investment in specific AI technologies in the longer term. However, traditional lenders such as banks in Ghana have very high collateral requirements and short loan maturity periods, discouraging potential entrepreneurs from pursuing opportunities in these sectors. Venture capital is the preferred investment vehicle in such scenarios. However, Ghana's venture capital industry is currently nascent, with very little legal protection for local or foreign investments. Access to capital is important for market activities to flourish in any sector, especially in this case. Therefore, the government must work on policies to make it easier for low-capital ventures to get funding via venture capital.

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[51] *What is Microcredit? – Grameen Bank*. (n.d.). Grameen Bank. Retrieved August 28, 2022, from https://grameenbank.org/what-is-microcredit/

[52] *BRAC: Creating opportunities for people to realize potential*. (n.d.). Https://Www.Brac.Net/Images/Factsheet/MF_Briefing_Doc_English.Pdf. Retrieved August 28, 2022, from https://www.brac.net

[53] *Microfinance*. (n.d.). BRAC. Retrieved August 28, 2022, from https://www.brac.net/program/microfinance/

Appendix 2 - AI Ecosystem & Policy Analysis

Ghana's Artificial Intelligence Ecosystem Mapping: Initiatives, Stakeholders, and Policy Landscape

Developed by The Future Society (TFS) for Ministry of Communications and Digitalisation, Smart Africa, GIZ FAIR Forward

Last updated: Spring 2022

Photo by Ifeoluwa A. on Unsplash

Around the world, AI is becoming increasingly pervasive in our lives as a "general-purpose technology." As described in Smart Africa's "AI for Africa" Blueprint report[54], AI brings major opportunities to Africa to achieve sustainable growth and development. Technological advancements in AI are being enabled by greater digital connectivity, increasing amounts of data, advanced algorithms, and gains in computing power. While most AI development and applications are currently in advanced economies, AI also has great potential to transform emerging economies.

In Ghana, the responsible adoption of AI has the potential to help the country by driving inclusive economic advancement. However, although the opportunities of AI are large, they are inextricably connected with risks, including algorithmic bias, widening inequality gaps, lack of transparency and explainability of algorithmic outcomes, cybersecurity, privacy and safety concerns, and gaps in inclusion and data governance. These require developing smart AI governance, carefully balanced by ethical guidelines for responsible AI adoption.

While AI has tremendous transformative potential that can positively impact all sectors in Ghana, such as healthcare, agriculture, education and other forms of public and private service delivery, Ghana has not yet taken full advantage. Beyond Ghana, the African continent as a whole still lags behind. A measure of Oxford Insights' governments' readiness for AI adoption revealed that the African continent scored the lowest on average. Moreover, few countries in the region have set out their vision for the implementation of AI.[55] Generally, African countries lack the preparedness to harness the tools that widespread adoption of AI would bring to solve many of the continent's most pressing social and economic challenges.[56]

Nonetheless, Ghana has numerous advantages and strengths that can be harnessed to enable a local Ghanaian AI ecosystem. For example, some notable AI activities in Ghana have stemmed from the setting up of Google's first AI centre in Africa in Accra. For Ghana to take advantage of its burgeoning AI community, supporting and developing a responsible AI ecosystem with long-term benefits is critical. Furthermore, it is imperative for Ghana to ensure a responsible, inclusive and sustainable AI ecosystem. As much as AI wields positive transformative power, it has the potential to infringe on human rights and likely lead to biased decision-making as a result of the misuse of data. To this end, approaches and policies across stakeholders should be coordinated to equip and drive Ghana's AI ecosystem to harness AI opportunities while mitigating its risks. These activities require engagement with stakeholders across the public and private sectors, including corporates and startups, civil society, academia, and a keen understanding of the digital ecosystem and policy dynamics.

[54]Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf.
[55] Oxford Insights and the International Development Research Centre. (2020). Government Artificial 2 Intelligence Readiness Index 2020. https://www.oxfordinsights.com/government-ai-readinessindex-2020
[56] https://ircai.org/wp-content/uploads/2021/03/AI4D_Report_Responsible_AI_in_SSA.pdf

Artificial Intelligence In The Broader African Context

Responsible AI adoption offers opportunities across the African continent. Africa stands out as the continent with the youngest population in the world. According to the African Development Bank Group's report titled "Jobs for Youth in Africa: Catalysing Youth Opportunity Across Africa", Africa's youth population is rapidly growing and expected to double to over 830 million by 2050, positioning the youth as Africa's greatest asset in AfDB's estimation. Africa's young population, coupled with its urban populations[57] , presents challenges to address and opportunities to ensure the maximisation of the continent's resources. The age and population dynamics require a deliberate move by African governments to prioritise and ensure that the continent can fully leverage the plethora of advantages that digital technology brings.

In ensuring fair and equitable access by its youth and general population, AI can be a launch pad for Africa to make a paradigm shift to more efficient, optimal and transparent delivery of public services and infrastructure development. For example, in the healthcare sector, structural inequalities, shortages of qualified healthcare professionals or supplies, barriers to accessibility, affordability and rural and urban divides raise critical gaps that AI can help address.[58] Investing in digital technologies, including AI, will prepare Africa to generate new economies and contribute to and compete in a global economy. Strategic adoption of advanced digital technologies such as AI can provide employment opportunities for the youth in the AI value chain and opportunities for the continent's innovators and entrepreneurs to plug into global value chains.

To date, most countries in Africa have yet to bring digital technology advancement to the policy tables. There is renewed impetus by some African countries such as Ghana, Rwanda, Kenya, Mauritius, South Africa, Tunisia, Morocco and Egypt to set the wheels of change moving.[59]

Blueprint: AI for Africa (Smart Africa)

Smart Africa's *Blueprint: Artificial Intelligence for Africa* report presents key elements and advice for national AI strategies and international coordination in Africa. The blueprint is based on the view that "successful global cooperation is best achieved from a common African position on AI while guaranteeing African AI sovereignty. This calls for regional coordination of AI strategies, economic initiatives and policies."[60]

All African countries adhering to the Smart Africa Manifesto participate, with the founding members being the African Union (AU Commission, NEPAD Agency, specialised institutions and

[57]Three African cities have some of the largest populations in the the world with Lagos, Nigeria leading with ~88,344,661 inhabitants, followed by Kinshasa in DRC with ~83,493,793 inhabitants and then Dar Es Salaam, Tanzania at about 73,678,022.
[58] Lannquist, Y., 2021, "Opportunities & Challenges of AI in Healthcare in Africa," The Future Society. https://thefuturesociety.org/2021/07/22/opportunities-challenges-of-ai-in-healthcare-in-africa/
[59] https://oecd.ai/en/dashboards and The Future Society.
[60]Smart Africa, GIZ and GFA Consulting, "AI for Africa" Blueprint, 2021, https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf

Regional Economic Communities), International Telecommunications Union (ITU), World Bank, African Development Bank (AfDB), UN Economic Commission for Africa (UNECA), GSM Alliance (GSMA), ICANN, African Telecommunications Union (ATU) and the Private Sector. The Republic of South Africa, one of the Smart Africa member states, has committed to championing the development of this blueprint as part of its flagship project, “4th Industrial Revolution: innovation and artificial intelligence.”

Key Objectives:

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

The report proposes the application of 6 principles to the development of an African AI Strategy:

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

Key aspects of the report were presented by Khumbudzo Ntshavheni (Minister of the Ministry of Communications and Digital Technologies, South Africa) in his Remarks on the Launch of Africa's AI Blueprint at The Smart Africa Board Meeting on 10 November 2021:

- The African continent must set up regional Centres of Excellence for AI specialising in different fields of AI to ensure cooperation and collaboration
- Ethical considerations and human development must remain the focal point in the adoption and use of AI
- Data preservation is re-positioned as an economic tool that must be effectively managed and utilised for the economic development of individual countries and the continent
- Specific economic sectors can be highly advanced through the adoption of AI and through taking advantage of current plans
- Proposal for a high-level roadmap that member-states can consider in tackling AI adoption and deployment
- Proposal for important policy and regulatory approaches to address AI risks

Enablers of the AI Ecosystem

Human Capital

Digital skills, Science, Technology, Engineering and Mathematics (STEM) and Information Communication Technology (ICT) education are critical to developing AI and digital economies. Through its Ministry of Communications and Digitalisation, the government has embarked on several initiatives to build the human capital of Ghana's digital economy. These initiatives are mainly targeted at particular demographic groups to fill gaps. The digital skills programmes are expected to equip and prepare the Ghanaian workforce for future work in emerging technologies.

These initiatives include:

- **Girls-In-ICT:** targeted at building digital skills and talent development among girls.]
- **Youth in ICT:** digital and human capacity building among Ghanaian youth
- **Youth Employment Agency (YEA):** digital skills building towards human capacity development among the unemployed youth in Ghana
- **National Robotics Competition:** STEM education through robotics competition among 16 selected senior high schools and five primary schools from May 2021
- **NABCO**[61]: Using drones to clean the natural environment has faced devastation over the past years. In 2018 130 NABCO graduates were taken through drone piloting training at the UMaT to start work as drone pilots for monitoring artisanal mining activities in the various mining districts.

The *Civil Society* section of this report includes additional programs targeting AI skills development for the community.

Innovation & Entrepreneurship

Entrepreneurship is a key vessel for AI adoption. With the pivotal goal of supporting and ensuring thriving innovation clusters across the country, the Ghana Tech and Business Hubs Network was established. Hubs like iSpace, Impact Hub, Kumasi Hive, the HOPin Academy, iCode in Takoradi and Ho Node in the Volta Region have been operational. According to GIZ's Make-IT, the innovation ecosystem in Ghana has developed enormously over the past couple of years.

The following table provides background for Ghana’s innovation environment:

Indicators for Ghana’s innovation environment

[61] https://bestnewsgh.com/130-nabco-drone-pilots-for-illegal-mining-acquires-military-training-at-asutsuare-military-camp/

Index/Ranking	Score
Global Competitiveness (n=141)	111
Financial system (n=141)	116
Market Capitalisation % GDP (n=141)	76
Venture Capital availability (1-7 (best))	3
Legal framework's adaptability to digital business models (1–7 (best))	4.0
ICT adoption (n=141)	90
Access to electricity (% of the population)	84
Innovation capability (n=141)	89
Unemployment rate (%)	7
Income Gini (0-1) (absolute inequality)	0.44

Source: World Economic Forum Global Competitiveness Index 2019, World Bank Indicators, Oxford Insights.

Ghana performs well relative to its peers in Sub-Saharan Africa: Rwanda, Benin, Tanzania, Nigeria, and the Democratic Republic of Congo rank 100, 125, 117, 116, and 139, respectively, on the same list. Specifically, Ghana scores very favourably on three key metrics: ICT adoption, access to electricity, and innovation capability. However, it scores low on the health of its financial system and the availability of venture capital. This indicates that the infrastructure for rapid AI adoption and uptake is available, but the main bottleneck is potential entrepreneurs' lack of access to funding for new ventures. Specifically, existing entrepreneurs cite the very high collateral requirements for loans as a major barrier to starting any new venture[62]. This is especially true in the ICT sector, where fixed assets that can be pledged as collateral for loans often comprise only a small fraction of other major non-tangible assets like software intellectual property. Venture capital fills this funding gap in the top-performing countries on the list. In Ghana, the venture capital sector is still nascent and mainly focused on funding extraction services, which explains the country's low score in venture capital availability.

Incubators, Accelerators and Hubs

Currently, Ghana has more than 34 tech hubs located in Accra and the rest of the country.[63] The proliferation of startups and entrepreneurial activities in the tech space can be attributed to high-quality talent and an ecosystem of players such as the Meltwater Entrepreneurial School of Technology (MEST), Ghana GTL Incubator Programme, and the support of development

[62] http://hdl.handle.net/10986/36580
[63] https://make-it-initiative.org/africa/about/ghana/

partners or donors. For example, Ghana Tech Lab (GTL)[64] is a joint venture between Innohub Ghana and Kumasi Hive under the E-Transform Project of the Ministry of Communication and Digitalisation and funded by the World Bank. GTL provides a tech space for competent digital skills training, seeding innovations and growing startups.

Disrupt Africa (2018) reported that investments in Ghanaian startups accounted for 11.4% of total African startup investments. A list of AI startups can be found in this report's 'Private Sector' section.

The Ghana Tech Lab (GTL) Free Incubator Programme[65]

- In 2019, the programme enrolled 28 AI startup ideas from across the country. The incubator aimed to help drive AI innovation in Ghana by providing entrepreneurs with tangible resources and expert coaching ideas. Fifty-six entrepreneurs, divided into 28 teams of two, were selected to participate in the 10-week program after 300 individuals participated in a six-week training programme organised by GTL in collaboration with partner hubs across the country.
- Local hackathons allowed the entrepreneurs to pitch their ideas. The 28 projects selected are to be provided with coaching and mentorship from industry experts, exposure to industry events, and GHS 15,000 seed funding to help develop their ideas into feasible startups.
- Fourteen Ghanaian AI startups in the incubator program pitched their innovative ideas to compete with industries in Ghana and Africa.[66] This came after the 6-week training programme in AI to upskill, develop and grow viable startups that solve pertinent problems in the country.

The Africa AI Accelerator Program in Ghana provides useful lessons for enabling entrepreneurship in the nation.[67]

Digital Infrastructure

Digital foundations are necessary for an AI economy. Though Ghana's advancements in digital infrastructure are strong, more progress is needed to enable AI practitioners and harness the full potential of AI.[68]

The following are some projects that are either planned or ongoing to reinforce digital infrastructure in Ghana:

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[64] https://acceleration.ghanatechlab.com/
[65] https://disrupt-africa.com/2019/10/21/28-ai-ideas-enrolled-in-ghana-tech-lab-incubator/
[66] https://ghanatechlab.medium.com/
[67] Sey, A., and O. Mudongo. Case studies on AI skills capacity-building an AI in workforce development in Africa. Artificial Intelligence for Development in Africa, Research ICT Africa. https://researchictafrica.net/wp/wp-content/uploads/2021/07/AI-Capacity-Case-Studies-Final.pdf
[68]https://www.moc.gov.gh/projects

- **E-Government Infrastructure Platform Project**

An infrastructure by the National Information Technology Agency (NITA) to connect all Ministries, Departments, and Agencies (MDAs) and Metropolitan, Municipal, and District Assemblies (MMDAs) across Ghana. NITA has also built a Tier 3 data centre to host all government applications and has decided to commercialise its excess capacity to generate more revenue to support developmental work (Ghana Digital Economy Diagnostic, The World Bank).

- **E-Transform Project**

Ghana has been a pioneer in the African telecommunications sector, leading the region in market liberalisation deregulation and serving as a hub for submarine cables linking southern and northern Africa to Europe with impressive internet bandwidth and improved communications infrastructure. However, despite the recent significant increase in internet bandwidth and huge price reduction of devices as well as usage charges, internet users in Ghana are still a small share of the total population, and mobile broadband usage is low.

Indicator	Baseline (2013)	Current (February 26, 2021)	Target (October 31, 2023)
Average days required to process a birth certificate	15	7	5
Average days required to process a company registration	4	2	1
Number of new e-Government applications providing services to the public under the e-Transform project	3	7	7
The number of new e-Services available to the public online under the project	8	15	16
The number of teachers and students using education portals, including those in rural areas.	0	0	150,000
Number of teachers and students using education portals, including those in the rural areas, which are Females(%)	0	0	40

Source: GH eTransform Ghana|The World Bank

Intermediate result indicators from the e-Transform Project

Indicator	Baseline (2013-2020)	Current (2020 - 2021)	Target (2020 - 2023)
The Number of people trained under the project	0	9,943	3,000
The Number of people trained, of which the number of females trained	0	4,350	1,200
The Number of students and teachers benefiting from enhanced internet access	0	200,000	150,000
# of students and teachers benefiting from enhanced internet access of which are female(%)	0	45	40
The Number of transactions processed under eProcurement and e-Immigration systems	0	120,000	100,000
The Number of active judicial cases processed through automated case management systems in Ghana's Law Courts	0	51,232	90,000
The Number of locations of higher education benefiting from enhanced bandwidth	27	35	60
Tech Hubs in Ghana, supported by the project	0	3	3
Number of pages of Government records digitised	17, 500,000	44,286,840	40,000,000
Certification authorities' operations in Ghana	0	1	1
The Number of locations of Government Ministries, Departments, and Agencies (MDAs) benefiting from enhanced bandwidth under the project	0	180	240

Source: GH eTransform Ghana|The World Bank

Telecommunications Infrastructure Indicators, 2017 for Ghana

Infrastructure Indices	Score

Fixed Telephone lines/100 pop	1.05
Mobile Telephone Subscriptions/100 pop	127.46
Mobile Internet Users 100/pop	34.6
Mobile Internet Bandwidth, Mbps	7.11
Fixed Broadband internet users/100 pop	0.2
Fixed Line Broadband Bandwidth/Mbps	25.11
Mobile cellular prices in US$	3.01

Source: ITU, 2017 | Adopted from Ghana Digital Economy Diagnostic Stock Taking Report (2019)

- **Eastern Corridor Fibre Optic Backbone**

In 2008, the Government of Ghana initiated the nationwide e-Government infrastructure. The infrastructure is intended to extend the national backbone infrastructure to all districts in the country, provide national data centre facilities and connect all public institutions to single shared communication and computing infrastructure to facilitate efficient delivery of government services to businesses and others.

Submarine Cables In Ghana in 2017

As of 2017	Capacity Available to Operator (Gbps)	Capacity Available in use
Glo-Glo 1	20	6
MTN-WACS	25	20
Vodafone- SAT- 3	5.645	43.1
MainOne-MainOne cable	270	22.09
Kasapa- Dolphin	20.6	1.15
Total	341.25	92.34 (usage 27%)

Source: Ghana Digital Economy Diagnostic Stock Taking Report(2019)|National Communications Authority

Telecommunications Infrastructure Indicators, 2017 for Ghana

Infrastructure Indices	Score
Fixed Telephone lines/100 pop	1.05

Mobile Telephone Subscriptions/100 pop	127.46
Mobile Internet Users 100/pop	34.6
Mobile Internet Bandwidth, Mbps	7.11
Fixed Broadband internet users/100 pop	0.2
Fixed Line Broadband Bandwidth/Mbps	25.11
Mobile cellular prices in US$	3.01

Source: ITU, 2017 | Adopted from Ghana Digital Economy Diagnostic Stock Taking Report(2019)

Cell phone coverage is high in Ghana: The GSM Association (GSMA) estimates 2021 coverage at 94% and 88% for 2G and 3G, respectively. 4G coverage is estimated to be lower at approximately 68%, although Ghana scores favourably to its peers in the region.

Cell Phone Coverage Comparison of Sub-Saharan African Countries

Country	**3G Coverage**	**4G Coverage**
Rwanda	82	85
Benin	89	60
Tanzania	81	55
Ghana	***88***	***68***
Nigeria	74	40
Sierra Leone	61	43
Democratic Republic of Congo	52	41

Source: GSMA analysis of data sourced from mobile operators, GSMA Intelligence, Centre for International Earth Science Information Network (CIESIN), household survey data, and Earth Observations Group (2021).

These national averages hide a deep rural-urban divide. For example, rural areas in Ghana have 4G coverage of only 41%, whereas urban coverage is more than twice that at 88%.

In addition to the wide disparity in cell phone coverage between rural and urban populations, there seems to be a significant difference between cell phone coverage and internet usage. GSMA further estimates that internet connectivity is only at 37% on average across the country. Although Ghana has met the affordability goal of making 1GB of data cost less than 2% of the

average monthly income per capita, data plan affordability remains the largest barrier to entry for a large number of people, especially in rural areas.

Internet Connectivity Comparison of Sub-Saharan African Countries

Country	Connected %	Usage Gap %	Coverage Gap %
Rwanda	7.8	80.3	11.9
Benin	27.2	61.3	11.5
Tanzania	20.6	62.6	16.8
Ghana	***37.0***	***51.4***	***11.6***
Nigeria	32.9	42.6	24.5
Sierra Leone	10.9	47.4	41.7
Democratic Republic of Congo	17.7	36.3	46.0

Source: GSMA analysis of data sourced from mobile operators, GSMA Intelligence, Centre for International Earth Science Information Network (CIESIN), household survey data, and Earth Observations Group (2021)

The leader in internet connectivity among Sub-Saharan African countries is clearly Nigeria. This comes as no surprise, given that Nigeria is the largest economy in the group by a large margin. Therefore, it is encouraging to see Ghana following Nigeria for internet connectivity by a thin margin. This is perhaps an indication that Ghana's steps to reduce barriers to entry for internet connectivity have succeeded. In fact, the data from GSMA shows that Ghana's data plan costs as a proportion of the monthly GDP per capita were *the lowest* among its Sub-Saharan African peers in 2020. However, it is worth noting that there is a downward trend for all the countries in the group for this time period, suggesting that people in Ghana looking to participate in the development of AI technologies would have to compete fiercely with people in peer countries. On the other hand, businesses looking to serve AI-enabled solutions now have a much larger market for their products in Sub-Saharan Africa than before. The latter, coupled with Ghana's participation and leadership in the African Continental Free Trade Area (AfCFTA), could act as a powerful incentive for entrepreneurs to create AI-enabled products.

Comparison of Cost of Data as Percentage of GDP Per Capita in 2016 and 2020

Country	2016 %	2020 %
Rwanda	3.1	3.1
Benin	9.6	4.2
Tanzania	3.1	2.6

Ghana	***2.2***	***1.0***
Nigeria	3.3	1.5
Sierra Leone	20.4	9.2
Democratic Republic of Congo	46.9	16.8

Source: GSMA analysis of data sourced from mobile operators, GSMA Intelligence, Center for International Earth Science Information Network (CIESIN), household survey data, and Earth Observations Group (2021)

Cell phone coverage and distribution across different areas of the country are crucial to understanding not only people's ability to participate in the digital (and AI) economy but also their potential to benefit from AI-enabled services. In addition, people's cell phone habits and connectivity to the internet will also dictate the service delivery of AI solutions to a large extent.

Data Access

Data is essential fuel for training AI systems. Sponsored by the Ministry of Communications and Digitalisation (MoCD), the Government of Ghana (GoG) has taken steps to support and promote government data sharing by launching two initiatives, namely, the Ghana Open Data Initiative (GODI) in 2012 and the Ghana Data Exchange Hub. The GODI secretariat is the focal place at NITA to coordinate the initiative and respond to queries from the data user community. The GODI is said to have created a central repository of datasets from 25 government agencies, including The Energy Commission, the Ghana Statistical Service, and the Ministry of Finance[69].
It is crucial to establish a governance framework for sharing government data, including implementing the National Open Data Initiative. The introduction of these open data policies will ultimately:

- Provide access to government data in a machine-readable format to enable the use of data made possible by these initiatives and address the absence of harmonised regulations, procedures, and strategies to manage and release government data.
- Establish calls for a comprehensive policy to guide government ministries, departments, and agencies in sharing government data.
- As part of the GODI, a policy document dubbed the Ghana Data Sharing Policy was developed in 2019.
- Also, a web portal (data.gov.gh) to enable proactive sharing and greater access to data generated and commissioned by the ministries, departments, and agencies of the Government of Ghana was developed to visualise key datasets in Ghana across different socio-economic sectors.

The MoCD, through its agency NITA, has been embarking on a project to address GODI's weaknesses since 2018. By June 2019, the GODI platform had hosted 90 datasets in open data

[69] Ghana Digital Economy Diagnostic Stock Taking Report, 2019

formats from 11 agencies. In addition, the World Bank's Ghana Digital Economy Diagnostic (2019) has reported that the MoCD has submitted a new draft policy on data sharing to the cabinet that envisions three phases: portal to receive datasets; building the ecosystem around the use of the datasets (for example, hackathons); and training for MDAs on data and change management. However, there are notable gaps in data access:

1. The absence of an open data license attached to government-produced datasets means that not all the data available on the data.gov.gh website is legally open according to international standards.
2. The currently available datasets are, for the most part, outdated, and some are not in the format for machine-readable or data processing.
3. There is no data collection procedure in place between MDAs focal points and GODI - data officers still collect siloed datasets from each MDA.[70]

Key Stakeholders

Given many initiatives and policies for digital development in Ghana, it is essential to coordinate and harmonise across all of the relevant stakeholders from the public sector (regulators, ministries, departments, and agencies), private sector (corporates and start-ups), civil society, and academia.

Public Sector

Key public sector actors important to the National AI Strategy include:

- Ministry of Communications and Digitalisation (MoCD)
    - Cyber Security Authority
    - Data Protection Commission
    - Kofi Annan Centre
- National Communications Authority (NCA)
- Ministry of Environment, Science, Technology, and Innovation (MESTI)
- Ministry of Lands and Natural Resources (MLR)
- Ministry of Finance and Economic Planning (MoF/MoFEP)
- Bank of Ghana (BoG)
- National Information Technology Agency (NITA)
- National Development Planning Commission (NDPC)
- Ghana Revenue Authority
- Ministry of Gender

Ministries that can advise and support responsible AI adoption in key sectors, such as the Ministry of Food and Agriculture, the Ministry of Health, the Ministry of Trade and Industry,

[70] World Bank Group. 2019. Ghana Digital Economy Diagnostic. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/34366 Licence: CC BY 3.0 IGO.

Ministry of Transport. The Ghana Enterprises Agency under the Ministry of Trade & Industry will be a key actor in supporting SMEs.

Private Sector

The AI ecosystem builds upon an existing and growing digital ecosystem, including the following leading actors.

Google AI Centre, Accra
In April 2019, the Google Artificial intelligence (AI) research laboratory was opened in Accra, Ghana – the first on African soil. The lab uses AI to develop healthcare, education, and agriculture solutions to improve lives and reduce inequalities (*Moustapha Cisse, Head of Google AI Centre).* Google is also said to be working with universities and startups in Ghana, Nigeria, Kenya, and South Africa to enhance AI development to build products that can solve Africa's problems today.

Key Objective(s):

- For specialist engineers and AI researchers to collaborate with local organisations and policymakers.
- To bring together top machine learning researchers and engineers to develop new AI applications. The centre will collaborate with local universities and research centres to build products to solve Africa's urgent problems.
- To focus on enhancing Google Translate's ability to capture African languages more precisely.

Google's reasons for choosing Ghana to build its AI laboratory:

1. Ghana has a relatively stable electricity supply
2. Relative security
3. A decent internet infrastructure resulting from an extensive fibre optics backbone in Accra
4. Ghana has one of the best travel and tourist locations in the region
5. A healthy pool of academic institutions with significant infrastructure
6. A hub of quality education

Glovo: Using AI for convenient shopping
Glovo[71] is a Spanish on-demand delivery digital application that uses AI technology to predict and suggest services close to customers depending on their location and previous order experiences. It is said to be present in 23 countries, with Africa representing 30% of its geographical footprint. The delivery service is taking advantage of the smartphone penetration in Ghana to bring the mobile app-based delivery service to the Greater Accra Region (Accra and Tema).

In the Africa Region, Ghana is said to be outpacing its peers in the adoption of mobile technologies; Ghana is second place behind South Africa.

[71] Techcrunch, 2021, "Glovo to double down African Investments in the next 12 months: But will it stay put?"https://techcrunch.com/2021/09/07/glovo-to-double-down-african-investment-in-the-next-12-months-but-will-it-stay-put/

Mobile and Internet Usage & Growth

ADOPTION/GROWTH			
+2.1% (Jan 2021 Vs Jan 2020) +655 Thousand	+8.1% (Jan 2021 Vs Jan 2020) +3.1 Million	+6.4% (Jan 2021 Vs Jan 2020) +943 Thousand	+36.7% (Jan 2021 Vs Jan 2020) +2.2 Million

Source: **DataReportal|Hootsuite**

Glovo was readily welcomed in the e-commerce market with the increase in the demand for convenient shopping. Glovo was well-positioned to play the role of the third party that ensures that its partners, be it pharmaceuticals, food, or groceries shops, can reach their customers at their convenience. Apart from the high penetration rate of smartphones and the widespread adoption of mobile payments being success factors for Glovo, there is also the factor of Google Maps, making use of AI technology. Based on Google Maps AI technology that has revolutionised the logistics industry in Ghana, Glovo is able to present to its users information such as restaurants nearby or the nearest service provider once a user selects their location.

Digital Payments Size & Growth of Market (January 2020 Vs January 2021)

DIGITAL PAYMENTS - SIZE AND GROWTH OF THE MARKET (IN USD)			
# Of People Making Digitally Enabled Payments Transactions	Total Annual Value Of Digitally Enabled Consumer Payments	Annual Change In The Digitally Enabled Consumer Payments	Average Value Of Annual Transactions Per User
6.62 MILLION	$ 2.97 BILLION	+56.2%	$449

Source: **DataReportal|Hootsuite**

Uber - AI for ride-hailing, predicting fares, time of travel, and rider safety

Uber was the first ride-hailing company to enter Ghana's emerging market with its mobile app-based transportation service. Uber's service offered an alternative means of transportation to the Ghanaian middle class and students. This segment of society preferred the convenience of ordering a taxi cab from the comfort of their current locations instead of walking some distance to hail taxis or "hop-in-hop-out" of the usually poorly ventilated and the "ready-for-the-scrap-buyers" popular public bus service in ghana called the "trotro." The issue of security during travel is one major challenge that ride-hailing apps like Uber have addressed. Besides the convenience and consistency offered as part of their services, the assurance of the security of a rider makes Uber a preferred choice.

NVIDIA Deep Learning Institute

NVIDIA offers local AI training with ongoing practical application experience in partnership with the Ghana Artificial Intelligence Association of Ghana.

NVIDIA's Head of Emerging Areas, Kate Kallot, highlighted the importance of individual AI developers, grassroots communities, and start-ups for AI innovation on the African continent. NVIDIA's Emerging Chapters Programme is specifically for Africa and other emerging markets with grassroots communities that need to build and scale their AI projects (TechCabal, 2020). AI communities in Africa consist of "individual developers who run their incubators, do their own AI research, and partner with the government and international organisations." NVIDIA supports the communities with workshops by its AI experts through the Deep Learning Institute Programme and provides its hardware to them.[72]

Huawei Technologies Ghana

- 10- Day Residential Training in Artificial Intelligence[73]:

In September of 2021, Huawei Technologies Ghana partnered with the Government of Ghana through its Ministry of Communications and Digitalisation (MoCD) to train fifty (50) women in about eight universities across the various regions in Ghana at a 10-day residential training in AI. The training was part of a tertiary edition of the ministry's Girls in ICT Programme aimed at training more women in basic information communication technologies like Artificial Intelligence, Cyber Security, Storage, Big Data, Internet of Things (IoT) and Cloud Service, commenced.

- Seeds for the Future-Women in Tech Programme[74]:

Again, in collaboration with the MoCD, Huawei Technologies Ghana launched the "first-all women" edition of Huawei's company's corporate social responsibility programme called the Seed for the Future in October 2021. The Seed for the Future programme aimed to develop the ICT skills of sixty (60) young women beneficiaries for the 2021 programme by enhancing knowledge transfer, promoting a greater understanding of the telecommunications sector, and bridging the communication gap between countries.

Some of the activities for the programme included 5G, Artificial Intelligence, Cloud, Big Data, IoT, Smart City, and Cybersecurity. The programme was also specifically designed to bridge the gender gap in technology.

- LEAP, a digital skills programme targeting 100K Africans[75]:

Another way Huawei Technologies contributes to the AI ecosystem through skills development is through its LEAP - Leadership, Employability, Advancement and Possibilities - a digital skills development programme aiming to upskill over 100,000 Africans. The LEAP programme, which is supposed to run for three (3) years, will focus on fostering strong digital leadership and a skilled ICT workforce, building a digital talent pool, and promoting digital literacy among citizens.

[72] https://techcabal.com/2022/02/16/inside-nvidia-plans-to-develop-africas-ai-ecosystem/
[73] https://thebftonline.com/2021/09/24/govt-huawei-to-train-50-students-in-ai/
[74] https://moc.gov.gh/60-female-students-benefit-huawei-programme
[75]https://www.itnewsafrica.com/2022/04/new-huawei-programme-to-upskill-100000-people-across-sub-saharan-africa/

- €155 million project to boost basic telephony services in rural areas[76]

The MoCD through Ghana Investment Fund for Electronic Communications (GIFEC), in November 2020 unveiled a €155 million project to boost basic telephony services in rural areas. This project is backed by Huawei's Rural Stark Technology, which will provide the gear for more than 1,000 cell sites to be built across the country at the end of 2020, according to the project.

This project aims to serve 3 million Ghanaians to be connected to "reduce the gap in the digital divide" in underserved communities, particularly people from the Atwereboana in the Ashanti Region. Boosting the telephone service in rural areas will impact "around 30% of Ghana's population" who live in rural areas with little or no access to IT and communications services.

- 200 Smartphones to boost rural digitalisation

Further to Huawei's support of the Rural Telephone Project, the company September 2021 donated 200 smartphones to support the digitalisation of some rural communities.

- Full solution for 1GW/500MWh Ghana solar-plus-storage project

In the power sector, Huawei's full solution 1GW/500MWh Ghana solar-plus-storage project is a move that will create possibilities and opportunities for intelligent power management that could make use of automation and, for that matter, AI.

MTN Ghana looking at AI to help Fight Mobile Money Fraud

In September 2022, the Ghana Chamber of Telecommunications, in a publication, reported that the mobile telecommunications operator MTN announced its move to employ the use of AI technology through an AI system to help the operator fight Mobile Money fraud in the first quarter of 2020.[77] MTN believes this investment in a security system with AI capabilities will help MTN secure its platforms against the activities of fraudsters.

Vodafone Ghana's Digital Assistant

TOBi[78], Vodafone's digital assistant, a AI-powered chatbot, is designed to bring 24-hour assistance to the telecoms company's customers. Vodafone aims to use this AI-powered assistant to help improve customer queries and the company's response time. The chatbox is also supposed to reduce the number of calls received at Vodafone's customer experience centre. TOBi is said to perform basic customer care functions with a vision to improve its abilities with time.

CSquared and GRIDCo

[76]https://developingtelecoms.com/telecom-business/telecom-regulation/10295-ghana-huawei-unveil-155-million-rural-connectivity-project.html

[77] https://thebftonline.com/2020/10/13/mtn-to-deploy-ai-others-to-fight-momo-fraud-2/

[78] https://thebftonline.com/2020/10/21/vodafones-friendly-digital-assistant-tobi-now-on-whatsapp/

[79]Another digital infrastructure initiative supporting the AI ecosystem development is the agreement between CSquared and Ghana Grid Company Limited (GRIDCo). CSquared, a broadband infrastructure provider, agreed with GRIDCo to lease GRIDCo's excess fibre capacity to mobile network operators and internet service providers in Ghana. The agreement is said to be aimed at enabling the deployment of broadband infrastructure to deliver high-speed data services to businesses and homes while focusing on remote areas.

VRA Smart City Project

In 2020, as the Volta River Authority(VRA) launched its 60th anniversary, the company looked at digitisation, smart cities and electric vehicles. The VRA's smart city project seeks to transform the township of Akosombo into a smart city and make it a technology hub for Ghana. This move by the VRA is an opportunity to contribute to the development of the AI ecosystem and create jobs and opportunities for ecosystem actors equipped with AI capabilities.

TechGulf and Graphic Communication Group Limited Sign MOU for Digitisation

This project will run over two years to digitise the Graphic Communications Group Limited (GCGL) newspaper publications from 1950 to 2000. The MOU also covers a project to digitise all in-house administrative forms and memos to enhance the company's operations.[80] The digitisation of GCGL's newspaper publications spanning 50 years will provide the AI ecosystem with historical data for training.

List of AI Startups in Ghana (non-exhaustive)

STARTUP	SECTOR
Kudigo	Retail and E-Commerce
Triva	Financial Services
Complete Farmer	Agriculture
minoHealth	Health
Health Direct Global	Health
Superfluid Labs	Technology
BACE Group	Software & Technology
Mazumma	FinTech
Clearspace Labs	Technology
Niqao	E-Commerce

[79]https://developingtelecoms.com/telecom-business/telecom-investment-mergers/11004-fibre-capacity-deal-aims-to-enhance-internet-access-in-ghana.html

[80] https://www.graphic.com.gh/

Okuafo Foundation	Agriculture
Fineazy	Financial Services
KaraAgro AI	Agriculture, AgriTech
Raba Rides	Transportation & Logistics
Utaska	Domestic & Professional Services
SuaCode	Education
Npontu	Big Data Analytics
Impact Tactics	Robotics Process Automation

Academia

Higher education and research institutions in the country are strong enablers of an AI ecosystem. These spaces train practitioners and offer leading researchers and engineers the opportunities to explore various innovations. During these experiments and investigations, challenging questions on the impact of the technology and, for that matter, AI are debated - an invaluable source of reference for policymaking and development of AI solutions and applications that could lead to solving some of the most pressing national challenges.

Examples of programmes and initiatives in academia driving AI in Ghana:

- **Academic City University College**[81] - The university announced six months ago that it had received approval from the Ghana Tertiary Education Commission to offer a degree in BSc Artificial Intelligence covering "unique and futuristic courses" such as AI, Robotics and Biomedical. As a result, the university college became the first in Africa to offer a degree in AI. The accreditation aligns with the college's commitment to "equip students with the requisite hands-on practical training and education to be Future-ready".
- **African Institute of Mathematical Sciences (AIMS):** The African Masters in Machine Intelligence brings AI education to Africa and contributes to building an ecosystem of AI practitioners committed to positively impacting our societies. It is a fully-funded one-year intensive graduate program that provides young Africans with state-of-the-art training in machine learning and its applications. One of its goals is to prepare well-rounded machine intelligence researchers who will respond to the present and future needs of Africa and the world. AMMI was launched at AIMS Ghana in 2019.[82]

[81]https://blog.acity.edu.gh/2021/08/29/academic-city-introduces-a-degree-in-artificial-intelligence-first-in-africa/
[82] https://aims.edu.gh/african-masters-in-machine-learning/

- **Kwame Nkrumah University of Science and Technology (KNUST)**[83] - The university was awarded a grant to fund the establishment of a Responsible Artificial Intelligence Lab (RAIL) under the AI4D Africa Multidisciplinary Labs project initiated by International Development Research Centre (IDRC) in January this year. RAIL aims to develop talents in data science and machine learning to help bridge the widening skills gap needed to champion Ghana's digital economic transformation agenda and the sub-region. Hosted by the Faculty of Electrical and Computer Engineering, this will be a centrally networked lab infrastructure, which will provide computing, research, training, and expertise transfer to satellite laboratories at Universitée Alioune Diop de Bambey (Senegal), The University of Cape Verde, and The Gambia Technical Training Institute. The lab's main activities will involve: promoting the digitalisation of products, processes, and services via innovative toolbox development for renewable energies, health, agriculture, and climate change use cases in close collaboration with local small and medium-sized enterprises (SMEs) and governmental bodies.

- **Responsible AI in Africa (RAIN) Network: IEAI collaboration with the Faculty of Electrical and Computer Engineering, KNUST**[84]
  The Responsible AI Network (RAIN)[85]– Africa was founded through a partnership between the Faculty of Electrical and Computer Engineering at Kwame Nkrumah University of Science and Technology (KNUST) in Ghana and the Institute for Ethics in Artificial Intelligence (IEAI) at the Technical University of Munich in Germany with the aim is to build a network of scholars working on the responsible development and use of AI in Africa. The growing need to understand how AI may impact or be accepted by society in various regions worldwide has resulted in the effort to build a network of scholars working on the responsible development and use of AI in Africa. Key objectives:
    - To bring together emerging researchers to discuss and build joint projects on the ethical and social challenges arising at the intersection of technology and human values, specifically related to sustainable development.
    - The network will provide a platform to promote cross-regional and interdisciplinary research collaboration through a series of virtual and in-person workshops.

- **University of Ghana**[86] - In a quest to highlight how Africa could capitalise on the power and benefits of AI to induce development, the university department of Computer Science, in collaboration with Google Africa, organised a symposium in June 2019 on the theme; "Challenging the status quo: The Role of Artificial Intelligence in Africa".

[83] www.knust.edu.gh
[84] https://ieai.mcts.tum.de/responsible-ai-in-africa-network/
[85]Responsible AI Network - Africa, https://rainafrica.org/. Retrieved on March 8, 2022.
[86] https://www.ug.edu.gh/news/university-ghana-hosts-google-ai-symposium

Civil Society & Community

The civil society and nonprofit community contributing to the AI ecosystem development in Ghana is diverse.

Numerous organisations are supporting digital and AI skills development in Ghana, such as:

- AmaliTech[87]
- Blossom Academy[88]
- Artificial Intelligence Association of Ghana - “An AI community for Ghana by Ghanaians" that gathers the community for occasional discussions and events.
- Africa Digital Rights Hub
- Deep Learning Indaba and Women in ML and Data Science (WiMLDS) Accra chapters
- Ghana Natural Language Processing (NLP)[89] - an open source Initiative focused on NLP for Ghanaian languages with applications for local problems
- Python Ladies in Accra

The Tony Blair Institute for Global Change is a not-for-profit supporting government capacity with offices in several African cities. The Accra office serves as its hub on the African continent for AI governance and ethics.

AI Impact on Gender Diversity and Bias

The 2021 report “*Engendering Artificial Intelligence: A gender and ethics perspective on AI in Africa*” by Policy[90] outlines the factors that drive or hinder AI innovation and ethical concerns surrounding the impact of AI on women in the African context.

Since AI systems are trained on data, populations that are underrepresented in digital data for certain use cases will experience less accurate predictions and outcomes. The use of AI systems that are not trained on representative data can perpetuate existing biases and widen the gap between genders - for example, in [91]Ghana’s workforce, the gender parity for tech roles and wage equality indices are scored at 4 on a scale of 1-7 and 43 out of a 153 ranking respectively. However, adopting AI tools could be handy where employers must match skills with jobs and match women with tech or AI skills to available jobs to mitigate biased hiring programmes.

AI can provide the tools to bridge the gender and diversity gap in sectors such as fintech and healthcare. For example, AI can help identify women in low-income homes to target financial inclusion products or training or recommend tailored financial products. In healthcare, AI can

[87] https://amalitech.org/
[88] https://www.blossom.africa/
[89] https://ghananlp.org/
[90] Borokini, F., Nabulega, S., Achieng’, G., 2021, *Engendering AI: A Gender and Ethics Perspective on Artificial Intelligence in Africa*. Pollicy. https://pollicy.org/resource/engendering-artificial-intelligence/
[91] WEF Global Competitiveness Index 2019, World Bank Indicators, Oxford Insights

help reduce maternal mortality through tracking, engagement and precision monitoring of pregnant and nursing mothers throughout their prenatal to postnatal cycles. However, the same technology can also present products and biases that exclude certain groups or minorities. For example, low-income groups and poor credit scoring could be left out of financial products that provide access to loans from financial institutions.

The following table identifies trends in gender diversity in Ghana.

Gender Diversity Indicators For Ghana

Index/Ranking	Score
Workforce Diversity (1-7 (best))	5
Gender parity in tech roles, (1-7 (best))	4
Gender wage equality for similar work (rank/153)	46
Female legislators, senior officials, and managers, %	42
Global Gender Gap Index ((0-1) gender parity	0.7
AI Government Readiness Index (172)	91

Source: WEF Global Competitiveness Index 2019, World Bank Indicators, Oxford Insights

Development Partners & Institutions

Through its Ministry of Communications and Digitalisation (MoCD), the government is leading the development of Ghana's National Artificial Intelligence Strategy, with support from GIZ FAIR Forward and Smart Africa, which The Future Society facilitates. The Future Society is a non-profit bringing expertise in AI policy, having recently supported Rwanda's National AI Strategy and other international AI policies.

From Autumn 2021 To spring 2022, The UN Global Pulse is undertaking a parallel project to develop AI ethical guidelines for Ghana.

GIZ FAIR Forward[92]

The National AI strategy will be supported through GIZ's FAIR Forward, which has the main goals to:

1. Remove entry barriers to AI – Access to training data and AI technologies for local innovation;

[92] https://www.giz.de/expertise/html/61982.html

2. Strengthen local technical know-how on AI – Capacity development in Africa and Asia;
3. Develop policy frameworks ready for AI – Ethical AI, data protection and privacy.

Smart Africa

SMART Africa is borne from an alliance of 30 African Heads of State and Government to accelerate sustainable socio-economic development on the continent, ushering Africa into a knowledge economy through affordable access to broadband and ICT usage.[93] The group is leading an AI working group with experts from the Member States, the private sector, international organisations, donors, academia and entrepreneurs for an AI blueprint for Africa. The AI blueprint for Africa hinges on the background that "successful global cooperation is best achieved from a common African position on AI while guaranteeing African AI sovereignty. This calls for regional coordination of AI strategies, economic initiatives and policies. Moving forward together and encouraging mutual learning among African governments, regulators, and societies promises to increase efficiency and leverage each partner's strengths in the regional development of AI."[94]

The SMART Africa Alliance has five pillars which reflect the five principles of the Smart Africa Manifesto. These pillars are (1) Policy, (2) Access, (3) e-Government, (4) Private Sector/Entrepreneurship and (5) Sustainable Development.[95]

[93] https://smartafrica.org/who-we-are/
[94] https://smart.africa/board/login/uploads/70029-eng_ai-for-africa-blueprint.pdf
[95] https://smartafrica.org/who-we-are/

Policy Context

The Ministry of Communications and Digitalisation (MoCD) has recently announced plans to develop regulations on AI. The ministry announced at the Data Protection Week celebration in January 2022 that Ghana will soon have its own AI regulation to guide the use of AI for stakeholders, as reported in an online news article by myjoyonline. The deputy minister stated that the need to regulate AI use is to meet the growing demand for technological advancement in the country.

There are several key policies aimed at driving digital innovation and development in Ghana, such as:

- Payment Systems and Services Act (PSSA), 2019 (Act 987)
- The National Financial Inclusion and Development Strategy
- Digital Financial Services (DFS) Policy
- The Ghana Digital Payments Roadmap
- ICT4AD Policy 2003
- National Telecommunications Policy 2004
- National Communications Authority Act of 2008 (Act 769)
- Electronic Communications Act (Act 775)
- Electronic Communications Act (Act 786)
- Electronic Transactions Act (Act 772) 21
- National Information Technology Agency Act (Act 771)
- National Communications Authority Act (Act 769)
- Digital Terrestrial Television (DTT) Broadcasting Policy (2016)
- Cyber Security Act 2020
- Ministry of Environment, Science, Technology, and Innovation (MESTI) Innovation Policies

Ongoing relevant policies that are yet to be launched by MoCD:

- Ghana Digital Economy Policy
- Ghana Integrated Digital Transformation Blueprint

Key Policies Driving Digital Innovation in Ghana

Policy 1	Payment Systems and Services Act (PSSA), 2019 (Act 987)
Description	AN ACT to amend and consolidate the laws relating to payment systems payment services and regulate institutions that carry on payment service and electronic money business and provide for related matters
Owned By	The Bank of Ghana
Key Objectives	To amend the existing legislation relating to payment systems and services in Ghana
Applies to	(a) A Bank (b) A specialised deposit-taking institution (c) A dedicated electronic money issuer, a payment service provider, (d) An affiliate of a bank, a specialised deposit-taking institution or a financial holding company, an agent of a bank, a specialised deposit-taking institution, a dedicated electronic money issuer or a payment service provider. (e) An affiliate of a bank, a specialised deposit-taking institution or a financial holding company, and (f) An agent of a bank, a specialised deposit-taking institution, a dedicated electronic money issuer or a payment service provider
When it was enacted	13 May 2019

Policy 2	The National Financial Inclusion and Development Strategy
Description	Developed in collaboration with the World Bank, it aims at increasing financial inclusion from 58 per cent to 85 per cent by 2023, helping create economic opportunities and reducing poverty.
Owned By	MoF/MoFEP, BoG
Key Objectives	To increase the adult population's access to formal financial services from 58 per cent to 85 per cent by 2023.
Applies to	Financial Services
When it was enacted	2020

Policy 3	Digital Financial Services (DFS) Policy
Description	It serves as a blueprint for how Ghana can leverage digital finance to achieve its financial inclusion goals. Covering four years and six thematic areas, the DFS Policy clearly outlines the steps the Government and industry can take to bolster the country's DFS ecosystem.
Owned By	MoF/MoFEP, BoG
Key Objectives	To build on technological advances to create a resilient, inclusive and innovative DFS ecosystem that contributes to social development and a robust economy with a thriving private sector.
Applies to	Financial Services
When it was enacted	2020

Policy 4	The Ghana Digital Payments Roadmap
Description	Designed in collaboration with the United Nations-based Better Than Cash Alliance, puts forward concrete steps to build an inclusive digital payments ecosystem. This includes better access to financial services, enabling regulation and oversight, and promoting consumer protection.
Owned By	MoF/MoFEP, BoG
Key Objectives	To leverage the efficiencies that digitisation brings to make savings in government operations and to increase the collection of government revenues
Applies to	Financial Services
When it was enacted	2020

Policy 5	ICT4AD Policy 2003
Description	The policy sets the road map for developing Ghana's information society and economy. It provides a basis for facilitating the country's socio-economic development in the emerging information, knowledge and technological age to be dominated by information and knowledge-based economies.
Owned By	MoCD

Key Objectives	To engineer an ICT-led socio-economic development process with the potential to transform Ghana into a middle-income, information-rich, knowledge-based and technology-driven economy and society.
Applies to	ICT Services and Industrial sectors
When it was enacted	March 2003

Policy 6	**National Telecommunications Policy 2004**
Description	This policy aims to define the framework within which the Ghana telecommunications sector will evolve towards a vision of bringing Ghana further toward the realisation of a true Information Society, which includes all citizens and provides the greatest opportunity for economic growth, social participation and personal expression.
Owned By	MoCD, NCA
Key Objectives	Every citizen and resident of the Republic of Ghana shall have high-quality, affordable access to information and communication services to help transform Ghana into a knowledge-based society and technology-driven economy.
Applies to	Telecommunications Industry, ISPs
When it was enacted	March 2003

Policy 7	**National Communications Authority Act of 2008 (Act 769)**
Description	AN ACT to establish the National Communications Authority as the central body to license and regulate communications activities and services in the country; and to provide for related purposes.
Owned By	MoCD, NCA
Key Objectives	It is to regulate the provision of communications services in the country.
Applies to	Telecommunications Industry
When it was enacted	2008

Policy 8	**Electronic Communications Act (Act 775)**

Description	AN ACT to provide for the regulation of electronic communications, the regulation of broadcasting, the use of the electromagnetic spectrum and related matters.
Owned By	NCA, MoCD
Key Objectives	
Applies to	Telecoms Network Operators & Service Providers
When it was enacted	2008

Policy 9	**Electronic Communications Act (Act 786)**
Description	AN ACT to amend the Electronic Communications Act, 2008(Act 775) to provide a minimum rate for international incoming electronic communication traffic and related matters.
Owned By	NCA, MoCD
Key Objectives	
Applies to	Telecoms Network Operators & Service Providers
When it was enacted	2009

Policy 10	Electronic Transactions Act (Act 772) 21
Description	AN ACT to provide for the regulation of electronic communications and related transactions and to provide for connected purposes
Owned By	NCA, MoCD
Key Objectives	The object of this Act is to provide for and facilitate electronic communications and related transactions in the public interest
Applies to	Electronic transactions and electronic records of any type
When it was enacted	2008

Policy 11	National Information Technology Agency Act (Act 771)
Description	AN ACT tht established the National Information Technology Agency to regulate information communications technology and to provide related purposes.
Owned By	MoCD, NITA
Key Objectives	It is to regulate the provision of information communications technology, ensure the provision of quality information communications technology, promote efficiency standards and ensure high service quality.
Applies to	ICT Sector
When it was enacted	2008

Policy 12	National Communications Authority Act (Act 769)
Description	AN ACT to establish the National Communications Authority as the central body to licence and regulate communications activities and services in the country; and to provide for related purposes.
Owned By	NCA, MoCD
Key Objectives	It is to regulate the provision of communications services in the country.
Applies to	Providers of public communications services
When it was enacted	2008

Policy 13	Digital Terrestrial Television (DTT) Broadcasting Policy (2016)
Description	A single national FTA digital signal multiplex platform will be created for all broadcasters utilising the same frequencies to transmit digital TV signals to homes across the country. Current frequency allocation to a single broadcaster should be capable of delivering signals for a minimum of twenty (20) standard definition (SD) programme channels to be created per multiplex and in accordance with the national transmission and compression standard (DVB-T2/MPEG-4).
Owned By	MoCD, NCA
Key Objectives	(a) To create the policy environment for the smooth migration of analogue broadcasting to digital terrestrial television (DTT) broadcasting. (b) To guarantee the availability of all existing terrestrial analogue television stations in digital formats in at least their current coverage areas. (c) To make available to all existing television households access to digital television services and ensure universal access to free-to-air television services. (d) To allow a dual illumination period not exceeding the second quarter of 2020. (e) To ensure the availability of digital Set-top boxes that conform to Ghana DTT receiver specification and its subsequent reviews in the market. (f) As much as possible, adopt and implement a framework to provide Set-top boxes (fully or partially subsidised) to the citizenry with emphasis on the aged, persons with disability etc.,

	based on the Livelihood Empowerment Against Poverty (LEAP) system. (g) To free up the relevant spectrum of economic value from the broadcasting service for telecommunication and any other services of value to the state. (h) To promote environmental sanity through co-location of broadcast transmission infrastructure. (i) To encourage the promotion of local content towards growth and job creation in the sector. (j) To set up a commercially oriented corporate body, Central Digital Transmission Company Limited (CDTCL), to run the platform for long-term viability and growth.
Applies to	Television and Radio Broadcasting
When it was enacted	2016

Policy 14	**Cyber Security Act 2020**
Description	AN ACT to establish the Cyber Security Authority to regulate cybersecurity activities in the country, promote the development of cybersecurity in the country and provide for related matters.
Owned By	Cyber Security Authority
Key Objectives	(a) Regulate cybersecurity activities in the country; (b) Prevent, manage and respond to cybersecurity threats and cybersecurity incidents; (c) Regulate owners of critical information infrastructure in respect of cybersecurity activities, cybersecurity service providers and practitioners in the country; (d) Promote the development of cybersecurity in the country to ensure a secure and resilient digital ecosystem; (e) Establish a platform for cross-sector engagement on matters of cybersecurity for effective coordination and cooperation between key public institutions and the private sector; (f) Create awareness of cybersecurity matters; and (g) Collaborate with international agencies to promote the cybersecurity of the country.
Applies to	Cybersecurity activities in the country

When it was enacted	2020

Policy 15	**Ministry of Environment, Science, Technology and Innovation (MESTI) Innovation Policy**
Description	In line with MESTI's mandate to promote science and technology application and to create the conditions and enabling environment for innovation to occur, MESTI has presented the **National Science, Technology and Innovation Policy,** which aims, in broad terms, to provide a framework for stimulating innovation in the economy and the society. https://mesti.gov.gh/wp-content/uploads/2017/07/Draft-National-STI-Policy-Document-10-July-2017.pdf
Owned By	MESTI
Key Objectives	**Basic Objectives** (a) Facilitate mastering of scientific and technological capabilities by a critical mass of the products of all institutions; (b) Provide the framework for inter-institutional efforts in developing STI and programmes in all sectors of the economy to provide for the basic needs of the society; (c) Create the conditions for the improvement of scientific and technological infrastructure for research and development and innovation; (d) Ensure that STI supports Ghana's trade and export drive for greater competitiveness and promotes a science and technology culture in society. **Long-term objectives (ten years and beyond)** (e) To create endogenous science and technology capacities appropriate to national needs, priorities and resources (f) To create a science and technology culture whereby solutions to socio-cultural and economic problems of individual Ghanaians, their communities and the nation as a whole are recognised and sought within the domain of science and technology **Medium-Term Objectives(between five and ten years)** (g) To accelerate the promotion of innovation through the development and utilisation of modern scientific and technological capabilities to provide for the basic needs of the citizenry (h) To create the conditions for Ghana's competitiveness. **Short-Term Objectives(up to five years)**

	(i) To restructure the entire science and technology machinery, infrastructure and programmes to make them more responsive to national needs and priorities in all sectors of the economy
Applies to	All ministries, departments, agencies, and sectors for social and economic development.
When it was enacted	May 2017

Yet to be launched Digital Innovation Policies by MoCD:

Policy 16	**Ghana Digital Economy Policy**
Description	The Government of Ghana, acting through the Ministry of Communications and Digitalisation, in keeping pace with the global agenda of developing smart ecosystems, as a catalyst for digital transformation, is rolling out a Digital Economy Policy.
Owned By	GoG, MoCD
Key Objectives	To propel the entire traditional economy through the digitalisation drive for year-on-year progressive transformation impact improvement.
Applies to	All sectors

Policy 17	**Ghana Integrated Digital Transformation Blueprint**
Description	The Ghana Integrated Digital Transformation Blueprint (GIDTB) - a first of its kind - is a workable framework of the Government of Ghana (GoG) that stipulates pivotal actions, provides concrete steps and lays out a trackable path to achieving a digital society that responds to the changing dynamics of the times and empowers people and businesses to thrive by 2030.
Owned By	GoG, MoCD, MOFEP
Key Objectives	(a) Present a trackable and measurable framework for achieving Integrated Digital Transformation for Ghana over the next ten years; (b) Ensure sustainable digital transformation by establishing the guiding principles and shared values for delivering Ghana's Integrated Digital Transformation Agenda;

	(c) Identify critical sectors to anchor Ghana's Integrated Digital Transformation journey for ultimately the benefit of the people of Ghana; (d) Deepen coordination among key stakeholders to harmonise the implementation of the critical Digital Initiatives; (e) Establish opportunities for resource mobilisation, investments and innovative financing through the government's sources, the private sector, development partners, and other non-governmental sources.
Applies to	All sectors of the economy
Period	2021-2030

Digitisation Initiatives and Programmes[96]

I. MDAs Public Records Digitisation

Under the e-Transform project, the government, through the MoCD, aims to convert public records into digital forms from different government entities that could be integrated to provide more seamless and efficient public service delivery. Furthermore, the initiative aims to support more timely and accurate data for an Open Data Portal. In addition, digitising all public records is a great job creating opportunities for unemployed youth with digital skills.

II. MDAs Digitisating Capacity Building Programme

In collaboration with the Rockefeller Foundation Digital Jobs For Africa initiative, the World Bank's team supported the government's digitisation efforts by delivering a capacity-building programme in 2014. The programme mainly sought to build the institutional capacity of priority government agencies managing critical public records and therefore strongly needs digitisation. The focus of the capacity-building programme was how MDAs could manage their digitisation programmes in a more structured and sustainable manner.

III. E-learning Portal For MDAs

Through the digitisation programme of public records done as part of the e-Transform project, digital content was developed, and an e-learning portal was launched. The e-learning portal would provide "continuous self-paced learning opportunities" for MDA staff. Ultimately, the portal would be open to all MDAs and potential digitisation outsourcing agents.

This program (2014/2015) applies to MDAs, including The births and Deaths Registry (BDR), National Identification Authority (NIA), Registrar General's Department (RGD), Ghana Revenue Authority (GRA), Judicial Service of Ghana (JSG), Driver and Vehicle Licensing Authority (DVLA), Ghana Health Service (GHS) and Ghana Immigration Service (GIS).

[96] https://blogs.worldbank.org/digital-development/big-steps-toward-ghana-s-digital-future

ICT Standards and Guidelines by NITA[97]

Set by NITA, the purpose of the ICT Standards and Guidelines is to ensure the provision of quality ICT; promote efficiency standards, and ensure high quality of service. The standards also aim to facilitate the coherence in the MDAs' ICT investments and activities and the implementation and monitoring of the national ICT policy.

The standards are guided by the National Information Technology Agency Act 2008, Act 77. Implementing these standards and guidelines will deepen regulatory compliance for a successful digitisation agenda in Ghana. Also, when effectively implemented, NITA expects the ICT Standards and Guidelines to help address issues of fair competition among industry players, drive the growth of the country's Value Added Services (VAS) space, and ensure close collaboration between stakeholders and NITA as a policy implementer.

Mapping ICT Skills in Ghana

NITA also commenced the certification of ICT professionals and IT firms in Ghana. The certification of qualified IT professionals will help NITA know what IT specialists' skill levels are available (2021).[98]

The Ghana Digital Acceleration Project (GDAP)[99]

The Ghana Digital Acceleration Project (GDAP) is being implemented by MoCD and approved in March 2022. It aims to accelerate country-wide digital transformation while focusing on critical digital enablers that promote the digital economy and build on existing digital foundations. The project will also support complementary investments on the supply and demand sides of the digital economy. Based on recommendations of previous assessments by the World Bank, including the Ghana Digital Economy Diagnostic, the project will have activities that will support a robust enabling environment for fast-tracked digitisation. Furthermore, GDAP will promote a shift in digital government services from service to life-event focused to enhance the government's digital capabilities. Furthermore, GDAP is expected to increase Ghana's capacity to promote digital innovation and sector-wide transformation in selected strategic sectors. In addition, the project is expected to boost digital skills development and the capability to increase Ghana's digital talent base.

The objectives include:

- To expand access to broadband
- To enhance the efficiency and experience of selected digital public services
- To strengthen the digital innovation ecosystem

The project includes the following components:

- Component 1. Ensuring Inclusive and Safe Digital Transformation
- Component 2. Modernising Digital Government Services

[97] https://nita.gov.gh/guidelines/
[98] https://nita.gov.gh/
[99] Ghana Digital Acceleration Project (P176126), A World Bank Document

- Component 3. Digital Transformation of Strategic Sectors
- Component 4. Project Management and Implementation Support
- Component 5: Contingency Emergency Response

MoF and MOCD Compact for GhanaCares Programme[100]

This programme aims to accelerate ICT infrastructure and promote digital technologies for economic and social transactions. It is owned by the Ministry of Finance (MoF) and MoCD.

Priorities for the Communications and Digitisation Department

Prioritised under the Communication and Digitisation sector, under the GhanaCARES programme, accelerated digitisation is to ensure catalytic investment and development of communication infrastructure, integration and leveraging of data systems and platforms, enhanced capacity of key institutions and improved coordination with the private sector for improved service delivery, business expansion and economic transformation.

Specific interventions to fast-track digitisation for July 2020-December 2023:

i. Invest, consolidate, strengthen and expand the national fibre network backbone to expand and improve internet connectivity
ii. Promote increased digital literacy
iii. Support Ghanaian technology entrepreneurs by building tech and innovation hubs and also support the development and export of IT-enabled services such as business process outsourcing (BPO) firms
iv. Expedite implementation of government's digital initiatives (e.g. the National ID, digital address systems, etc.)

Specific Commitments and Targets for 2021[101]:

The Ministry of Communications and Digitalisation intended to work closely with the private sector to deliver the following agreed targets[102].

1. Inventory of all Government digital assets and services developed
2. Institutional ICT utilisation, capability, capacity, competency, skills and digital readiness enhanced
3. Public projects on Smart Workplace, National ID, Digital Address Systems, Land Records Digitisation, Births and Death Registry, www.ghana.gov, Health Records Digitisation, and virtual learning platforms expedited and consolidated
4. The regulatory capacity of the National Information technology Agency (NITA) and the Legislative Instruments (LI) for the Electronic Transactions Act and the NITA Act developed
5. Government of Ghana(GoG) fibre assets VRA, ECG, GRIDCO, Ghana Gas, BNC, GIFEC consolidated
6. Common National Digital Architecture designed and implemented
7. Ghana Integrated Digital Transformation(GDIT) Implemented

[100] Compact for Post-Covid Transformation
[101] Compact for Post-Covid Transformation
[102] Full target details can be found under section 3 of the Final MOCD CARES COMPACT 2021 YA_DD Document

8. Creation of Employment and Promoting Entrepreneurship

Gap Analysis of the Strategies and Policies of the Ghana Digital Economy and Innovation Ecosystem

The table below highlights key gaps in the AI ecosystem and provides thoughts on key steps that can lead to bridging the gaps. The gap analysis is drawn from Smart Africa and Digital Impact Alliance study that sought to understand country progress, benchmarked against the Digital Economy Blueprint for Africa. The study assesses ten countries in Africa that are member states, including Ghana. The gap analysis is also drawn from The World Bank's Report on Ghana's Digital Economy Diagnostic.

Digital Economy Pillar	Gaps Identified	Needs
Digital Government	• Significant progress in the governance of the digital economy despite weaknesses. • Trust in e-services offered by the government is generally low, and many Ghanaians are unaware that these e-services are available. • The challenge of updating strategies still exists, often requiring **significant resources and time from governments**. • **Siloed investments** and a **lack of cooperation** between ministries continue to exist, creating problems for national and sectoral decision-making, making it difficult to design and deploy coordinated digital and ICT strategies and plans.	• Have clear roadmaps and visions that identify relevant issues and paths to addressing them. • Documentation for strategic planning, a timeline for achieving objectives, and the development of KPIs to support monitoring and evaluation of progress towards a digital economy. • Synchronising ICT investments across the government requires innovative governance, funding, and interoperability approaches to avoid siloed planning, investment, and systems.

Infrastructure	● **Limited funding** for digital projects is still a challenge, as is acquiring private-sector and sectoral investments. ● A struggle with **improving connectivity** and digital literacy because of affordability issues and procurement challenges often create negative downstream effects for ICT and digital access, challenging the continued improvement of digital government services. ● Most of the infrastructure put in place by the government is concentrated in the urban and commercial areas, leaving a large section of the country's **rural areas without functional coverage**. ● Issues in coordinating infrastructure investment and rollout, extending **connectivity to low-income** and **marginalised populations**, and creating incentives for private sector infrastructure investments (mainly in rural areas). **Internet cost** remains on the high side in the country with **low access**, especially in rural areas. ● Providing reliable and fast broadband connectivity for MDAs and MMDAs across the country is also still challenging.	● Adopting a centralised procurement, deploying enterprise architecture frameworks for interoperable systems, harmonising IT systems and authorities, and introducing cost-efficient measures for IT resources across government. ● Coordinated and centralised approaches would need to be across the whole government and accompanied by supporting policies to provide for more efficient and sustainable institutions, platforms, and governance. ● The need to devise innovative financing models that promote the efficient use of existing resources on the one hand and investment incentives for the private sector and other development partners on the other. ● Putting centralised procurement mechanisms and other processes that provide better value for the money and encouraging public-private partnerships in developing ICT infrastructure and reducing the cost of access.

Digital Platforms	● Lack of sectoral **ICT strategies** in important areas like **commerce** and cross-cutting areas like **gender** and **disability.** ● The different MDAs often lead initiatives with **parallel and overlapping activities; therefore,** there is a **lack of coordination and streamlining** of programmes. ● **Platform diffusion is low** - only 28% of domestic firms have an online presence, and only 7.8% of people perform online transactions. ● Despite strong moves toward electronic payment infrastructure, the **country remains a cash-based** economy - 98% of payments are still being done in cash, and the main non-cash instrument continues to be cheques - this may be a result of **trust issues** with using digital payment platforms, **low penetration of debit and credit cards** and **low availability of POS devices** at merchant points. ● **No business rules** are in place to govern pricing and other aspects of e-payment schemes, prompting many providers to discourage their customers from sending money off-net by increasing the fees for these transactions. ● With BoG mandating in May 2018 that all mobile money providers connect to GHLink, with full interoperability between mobile money providers and banks introduced in December 2018, FinTechs are not yet connected to GHLink, with no clear rules around participation in the scheme.	● Again, adopting a centralised framework for interoperable systems, harmonisation of digital systems and authorities, and introducing cost-efficient measures for resources across government. ● Ensuring the sustainable rollout of ICT infrastructure requires governments to secure funding, particularly for core digital platforms projects such as digital identity, which are catalysts for digital inclusion and connectivity, and create an enabling policy and regulatory environment that incentivises different stakeholders (e.g., private-sector and other funders) to invest in the development and maintenance of these projects. ● Emphasise public sector digital capacity building - building a strong team of government ICT professionals who work with other technical specialists will increase the effectiveness and efficiency of the existing digital government platforms and their further development. ● Establish a regulatory sandbox for Digital Commerce and Gig Economy labour regulations - a regulatory sandbox will provide a safe place to test innovative approaches in collaboration with the private sector. ● Develop a coordinated digital commerce support programme. The programme should take advantage of ongoing local government efforts such as NYA and NEIP, regional efforts like the Nairobi Manifesto on Digital Economy and Inclusive Development in Africa (UNCTAD, 2018) and private digital platforms to increase the cross-border market such as Jumia.

Digital Skills and Value	● Proactive steps have been taken to address digital skills and talent development gaps. However, there is still a challenge in **improving connectivity** and creating an **enabling ecosystem**, which affects the **talent pipeline** for the government and the private sector. ● Also, only a few Ghanaians below the numbers required for a successful and **inclusive** digital economy are said to possess the **requisite digital skills** and experience beyond the basic use of a computer or tablet. ● The private sector is paying a **premium for digital skills,** making it significantly difficult for the public sector to **retain people** with such skills. ● The implementation of building a workforce with strong digital skills - the current National ICT in Education Policy for Ghana(2015), continues to face many challenges: the **absence of computer labs** in schools, few or no computers in schools, **lack of ICT teachers** and **unstable or no power supply**. ● Ghana is ranked 48th and 87th on quality of education and internet access in schools, respectively, in a Global Competitiveness Report done for 2017- 2018.	● Improving citizens' digital skills and values and local content creation necessitates working with the private sector, civil society, and local creators to improve access to education, particularly for marginalised and low-income communities; encourage digital literacy and upskilling; promote a culture of innovation and entrepreneurship. ● Improve basic digital skills provision in the education system. To spur improvement, policymakers must create frameworks for public education institutions to leverage up-to-date digital skills training content. ● Make computers and other ICT tools like mobile/smart devices equitably accessible to all, especially for rural areas, by improving basic school infrastructure needs. ● Align intermediate digital skills taught with future workforce needs - this should be aimed at both school-age and pre-employment/postsecondary levels. Critical intermediate workforce skills in most demand like digital marketing, data analytics and professional software should be given much attention. ● The public sector should partner with the private sector to access significant resources for advanced digital skills to upgrade the provision and coverage of effective training.

Innovation Driven Entrepreneurship	• Government's support for digital entrepreneurship is **uncoordinated** and consists of **multiple agencies** and programmes that provide **overlapping support** without a clear overall vision.
	• Poor business environment
	• **Lack of access to credit** and finance.
	• **Mixed quality** of entrepreneurial support.
		• Develop a digital technology adoption programme to accelerate the digital transformation of the economy, especially SMEs. This can be made possible by joint efforts among the Government and IT sector to help nurture digital transformation in Ghana's public and private sectors.
		• Provide incentives and platforms that foster collaboration between research institutions, universities and the private sector through collaborative research grants or centres of excellence for digital solutions.
		• Improve specific regulations for digital industries:
		  ◦ Creating tax policy, business registration, and insolvency rules that support startups and risk-taking entrepreneurial businesses;
		  ◦ Boost early-stage risk capital financing and access to credit for SMEs - restructure the VCTF to ensure it operates as a trusted intermediary in the VC ecosystem by enforcing clear independence governance;
		  ◦ Encourage partial credit guarantees and other risk-sharing mechanisms to lower the cost of capital from traditional financing institutions (banks) to startups and SMEs.

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