Uganda national AI landscape assessment

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Acknowledgements

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[1] Government of Uganda and International Telecommunication Union (ITU) joint project 'Technical Assistance and Training to Uganda on National ICT Development Strategy' (2021-2024), supported by the Global Development and South-South Cooperation Fund (GDSSCF) and ITU's ICT Development Fund (ICT-DF): http://www.itu.int/go/uganda-digital-transformation

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Foreword

Artificial Intelligence (AI), a key digital technology of the Fourth Industrial Revolution (4IR), is a transformative innovation that the Ugandan Government is dedicated to adapting to leapfrog development by using it to unlock productivity in agriculture, transform human capital development, overcome the economic opportunity shortfall, and support urbanization and governance.

This report presents findings from an assessment of the AI landscape conducted across key public and private organizations within the AI ecosystem. The objective was to evaluate its current utilization and the potential of AI and subsequently propose interventions to harness AI's economic and social benefits in Uganda while mitigating its potential adverse effects. The results of this report complement the aspirations of the Digital Transformation Roadmap and are aligned with the National Development Plan agenda.

I am optimistic that this report will provide valuable references and knowledge to a wide range of stakeholders within the Government and private institutions in the AI ecosystem. Realizing the potential of AI will require strengthening collaboration and partnership among all key public and private organizations in the AI ecosystem and enhancing ownership at all levels.

I implore all stakeholders, including government agencies, private sector actors, and development partners, to actively engage in implementing the recommendations outlined in this report. AI technology will strengthen Ugandan service delivery at all levels, enhance business competitiveness, accelerate socio-economic transformation and achieve inclusive and sustainable growth.

Hon. Dr. Chris Baryomunsi
Minister of ICT and National Guidance

Foreword

It is my pleasure to present this report under the project 'Technical Assistance and Training to Uganda on National ICT Development Strategy', a collaboration between the Government of Uganda and the International Telecommunication Union (ITU), supported by the Global Development and South-South Cooperation Fund (GDSSCF) and ITU's ICT Development Fund (ICT-DF).

Through carefully co-crafted interventions in support of the country's vision to transform Uganda into a digitally enabled society that is innovative, productive and competitive, the project has applied a three-pronged approach focusing on the development of policy recommendations, enabling capacity development, and the implementation of pilot projects.

In recent years, Uganda has witnessed tremendous growth in its digital economy, reflecting broader trends across the African continent and globally. The increased access to digital technologies, new opportunities that connectivity has brought, and the surge in digital services are fuelling rapid advancements on how citizens engage with one another and with vital Government services. These developments also bring new challenges, requiring policymakers and regulators to rethink strategically and build enabling policy and regulatory frameworks that are future-ready and adaptable to this ever-changing landscape. Moreover, digital skills remain an essential need for citizens to meaningfully participate in the digital space and for professionals to fully leverage the potential of digital technologies in addressing socio-economic challenges. This has been a critical aspect of the implementation of the policy interventions within this project.

This project, co-created and initiated in support of Uganda's ambitious digital transformation journey, stands as an example of how focused and meaningful partnerships can lead to impactful change. We have witnessed the results of the policy interventions and the impact of the significant capacity development in the country. I believe the efforts will continue to impact Uganda's transformation for years to come.

We encourage ITU Member States across the Africa continent and globally as well as development partners to join forces and invest in digital transformation for social and economic growth. The Telecommunication Development Bureau stands ready to continue supporting countries on their digital transformation journeys with impactful project implementation and partnerships which are essential for achieving universal and meaningful connectivity and digital transformation for all.

Dr Cosmas Luckyson Zavazava
Director of the Telecommunication Development Bureau
International Telecommunication Union

Foreword

The report on national AI landscape assessment and proposed interventions to harness the economic and social benefits of AI in Uganda is the result of a collaborative effort by diverse stakeholders committed to building a robust AI ecosystem in Uganda. It highlights key findings from an assessment of the AI landscape conducted across key public and private organizations within the AI ecosystem. It evaluates the current state of AI usage, potential and proposes intervention to harness AI's economic and social benefits in Uganda while mitigating potential negative impacts.

I extend my sincere gratitude to the International Telecommunication Union (ITU) for their technical support which has been pivotal in the development of this report. The partnership, with support of the Global Development and South-South Cooperation Fund, through the Technical Assistance and Training to Uganda on National ICT Development Strategy project has provided invaluable expertise and resources to ensure that this study aligns with international standards and best practices. I also extend my heartfelt gratitude to all stakeholders from government agencies and private organizations whose valuable contributions have made this report possible. This report is a testament to the collective dedication, collaboration, and commitment of various partners toward advancing an AI ecosystem in Uganda.

A special acknowledgment goes to the technical team at the Ministry of ICT and National Guidance. Their contribution to doing prior research, technical analysis and reviews were instrumental in shaping the recommendations presented in this report. I also extend my gratitude to the report's author and editors for their tireless efforts in gathering data, analysing trends, and synthesizing actionable recommendations that will guide our future initiatives.

As we move forward, I urge all stakeholders in government agencies and private institutions to remain actively involved in the development and implementation of Uganda's AI ecosystem. Together, we can collaborate to ensure that AI effectively supports key priority areas, driving the economic transformation of Uganda.

Dr. Amina Zawedde (PhD)
Permanent Secretary
Ministry of ICT and National Guidance
Government of Uganda

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Executive summary

Artificial Intelligence (AI), fourth industrial revolution (4IR) technologies and other emerging technologies such as augmented reality (AR) and virtual reality (VR) have the potential to dramatically improve lives and livelihoods across Uganda, as well as make remarkable progress towards achievement of the national development and economic objectives. The Ministry of ICT and National Guidance with support from the International Telecommunication Union (ITU) is implementing a joint project on "Technical assistance and training to Uganda on National ICT development strategy" 2021-2024. The project aims to enhance Uganda's ICT policy and regulatory landscape, fostering the nation's ongoing transformation into a digitally empowered, innovative, and competitive society. The project is aligned with the aspirations of the National Digital Transformation Roadmap and the third National Development Plan (NDPIII). Under the project a study was undertaken to understand the AI landscape in Uganda, assess shortcoming and opportunities while developing recommendations for interventions that the Government of Uganda can make to ensure that the country can harness the economic and social benefits of AI while minimizing its potential negative effects. Such interventions would seek to strengthen and put in place the necessary enabling policies, regulations, standards and underlying ICT infrastructure environment for deployment of Artificial Intelligence, among other 4IR technologies.

This report provides a detailed account of the findings from the AI landscape assessment done through a baseline survey detailed in section 3, stakeholder consultation in section 4, benchmarking study in section 5, risk management framework in section 6 and recommendations in section 7. A baseline survey was conducted to identify challenges faced by key public and private actors in the AI ecosystem, including but not limited to research and development, education, governance, marketing, and deployment, mapping also the AI stakeholders in Uganda across the value chain. A stakeholder consultation that was aimed at identifying opportunities and challenges faced by key public and private actors in the AI ecosystem was conducted. A benchmarking study was carried out on Rwanda and Kenya as countries that share economic similarities with Uganda and have made significant strides in creating an enabling environment providing supportive infrastructure for AI deployment and use. The developed AI regulatory frameworks, infrastructure and skills in the United States of America was selected as a reference for this assessment to ensure the findings are relevant and adaptable.

An assessment of the availability and extent of readiness of supportive infrastructure for the deployment of AI in the delivery of e-services by the government and evaluate the existing skills in AI development, deployment and use in government ministries, agencies and departments was conducted and finally a proposed AI risk management framework was developed.

The major findings include lack of appropriate AI infrastructure, skill gap in AI technologies, lack of AI policy, legal and regulatory framework, limited collaboration with academia and technology companies, absence of AI-focused curricula, unfavourable tax regimes for acquisition of AI equipment, accessories and infrastructure, and insufficient training programmes for AI professionals.

Recommendations that were made include call to Government of Uganda to create an AI enabling environment, invest in high-performance computing (HPC) infrastructure as this is critical for enabling large-scale AI workloads, develop an AI policy, strategy, legal and regulatory framework to guide the development and deployment of AI which is customized to Uganda, foster collaboration with academia and partner with technology companies in the AI space, engage in public-private partnerships (PPP) as this will facilitate government to address challenges in public service delivery and infrastructure development by leveraging the strengths of both public and private sectors. Expand the AI digital infrastructure and promote AI local solutions which brings all stakeholders on board. Provide AI-focused venture funds for the design and development of AI solutions and setting up of the AI ecosystem to support among others access and acquisition of the necessary tools and talents.

Abbreviations

Acronym	Meaning
4IR	fourth industrial revolution
AI	artificial intelligence
AWS	Amazon Web Service
BaaS	backup as a service
CCTV	closed-circuit television
CPU	central processing unit
DUV	Digital Uganda Vision
e-Government	electronic government
GPU	graphics processing unit
GCP	Google Cloud Platform
HPC	high performance computing
IaaS	infrastructure as a service
IBM	International Business Machines Corporation
ICT	information and communications technology
IT	information technology
ITU	International Telecommunication Union
KPI	Key Performance Indicator
KVA	Kilo Volt Ampere
ML	machine learning
MDA	ministries, departments, and agencies
NITA-U	National Information Technology Authority - Uganda
NLP	natural language processing
NPA	National Planning Authority
PPP	public private partnership
RAM	random access memory
TPU	Tensor Processing Unit
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDO	United Nations Development Organization

1 Introduction

The Ministry of ICT and National Guidance with support from the International Telecommunication Union (ITU) is implementing a joint project on technical assistance and training to Uganda on National ICT development strategy 2021-2024, supported by the Global Development and South-South Cooperation Fund. The project is aligned with the aspirations of the Digital Transformation Roadmap (2023/2024-2027/2028) and the third National Development Plan (NDPIII). It lays a foundation for ICT policy and planning with a focus on creating an enabling environment in Uganda for ICT innovations that will continue the digital transformation of trade, government, education, health, and other areas, and promote employment and sustainable development. The policy and strategy definition component of the project aims at providing technical assistance to Uganda on ICT policy and development strategies, which include formulation of recommendations aligned to the infrastructure and connectivity; digital services; and innovation and entrepreneurship pillars of the Digital Uganda Vision 2040. The capacity development component of the project aims to improve the policymaking and implementation capacity of government and affiliated agencies; and strengthen skills for the local ICT industry and the population at large to drive the country's digital transformation agenda. This will as well enable Uganda to continue transformation into a digitally enabled society that is innovative and competitive.

The Digital Transformation Roadmap aims to strengthen the implementation of enabling policies and laws to accelerate Uganda's digital revolution. It provides an overarching implementation framework for a connected Uganda that delivers on the opportunities presented by technology. While the Digital Uganda Vision sets the aspirational goals in alignment with the country's overarching Vision 2040, the Digital Transformation Roadmap lays out the concrete steps, the key enablers, and the milestones the county aims to achieve over the next five years. Given the dynamic nature of the ICT domain, the five-year cycle is to ensure that the country not only lay a robust foundation for the digital ambitions but also remain agile and responsive to the inevitable technological shifts that lie ahead. The NDPIII on the other hand aims to increase household income and improve the quality of life of Ugandans.

The project is delivered through three interconnected components, development of strategies and policy recommendations (component 1), capacity development (component 2), and the design and implementation of pilot projects (component 3). Under the project, Uganda is developing recommendations and strategies for supportive digital infrastructure for e-services including those that will leverage AI and related 4IR technologies. These technologies offer unprecedented potential for innovation, economic growth, and enhanced quality of life. However, to fully harness their benefits, nations must develop robust policies, laws and regulatory frameworks, skilled resources, enabling environment and infrastructures to govern their ethical and effective use.

Artificial Intelligence (AI), a key digital technology of 4IR, is a transformative innovation that the Uganda Government is dedicated to adopting and integrating into its development agenda to drive growth in key sectors such as agriculture, health, trade, urbanization, governance, finance and human capital development.

Artificial Intelligence has the potential to revolutionize service delivery and decision-making processes across all sectors. It can enhance public safety and security, support data-driven policy making, improve economic forecasting for better fiscal management and foster public engagement and feedback. Furthermore, AI can enable resource optimization, promote environmental sustainability and drive innovation to build economic resilience.

Artificial intelligence technology

Artificial intelligence can be described as the technology that can simulate human intelligence and emulate human capabilities to sense, comprehend, and act. This is augmented by the ability to learn from experience, perceive their environment, reason and in some instances respond to the environment and underlying circumstances accordingly. AI has the power to automate processes, analyse vast amounts of data, and provide real-time insights, which help decision-makers respond more effectively and efficiently to the needs of their citizens. For Uganda, AI offers an opportunity to address its unique socio-economic challenges and bring about transformative changes in key sectors.

AI system accepts data input in forms such as speech, text or image. The input is processed and analysed by applying various rules and algorithms. In some instances, the system uses its assessments to adjust input data, rules and algorithms, and target outcomes until desired results are achieved. The subfields of AI from desk review (Figure 1).

Figure 1: Major subfields of artificial intelligence

Source: Project research, 2024.

The AI development and deployment rely on a variety of technologies and tools each playing a role in different stages of the AI life cycle from data preparation to training, testing and deployment. The key areas from sources consolidated across the web (see Figure 2).

Figure 2 : Technology for development and deployment of AI systems

Source: Project research, 2024.

Artificial Intelligence is a digital technology which is a key part of 4IR, a technology that the Government of Uganda wants to domesticate (Uganda National 4IR Strategy, 2020). This new era of development in which digital, physical and biological systems converge, fundamentally transforming industries, economies and societies. The 4IR presents many opportunities for developing countries to leapfrog development by stimulating growth in areas such as agriculture, trade, logistics, urbanization and human capital development. Taking advantage of 4IR will play a big role in supporting Uganda to stimulate economic growth.

Uganda's 4IR strategy

The 4IR relates to convergence of digital technologies such as Artificial Intelligence (AI), cloud computing, block chains, big data, Internet of things (IoT), to create opportunities for economic growth, human development, improve competitiveness in areas such as biomedical technologies, harness agricultural productivity and e-commerce.

In 2018, a national task force to advise government on how to harness 4IR and AI for national development was established. The task force subsequently developed the Uganda national 4IR strategy with the vision of becoming a continent hub to enables smart and connected Uganda society. The mission of the strategy is to transform and accelerate Uganda's development into innovative, productive and competitive society using 4IR technologies.

The strategic objectives are:

a) Enhance the deployment of 4IR technologies in Uganda's key economic sectors to drive productive and value addition and commercialization.

b) Build a strong, healthy, knowledgeable and productive population by levering 4IR technologies.

c) Generate jobs through digitally traded export, automated financial services, and digitally augmented logistics.

d) Transform government performance through improved service delivery, quality of life and well-being.

e) Strengthen and stimulate research and innovation in 4IR.

f) Support national security in the physical and digital world.

Uganda's socio-economic challenges

As documented in the Uganda's Vision 2040 and the National Development plan (NDPIII), Uganda's socio-economic development challenges include:

a) Economy is heavily reliant on agriculture sector, which is vulnerable to climate change.

b) Inequality and poverty - significant disparities in wealth distribution exist, with a large portion of the population living in poverty.

c) Limited access to healthcare, skills mismatch and education with a system which does not adequately equip graduates with skills for the modern job market.

d) Low industrialization and value addition.

e) Urban challenges - rapid urbanization without adequate planning leads to slums, poor sanitation, and inadequate social services in urban areas.

f) High cost of capital which refers to challenges faced in obtaining financial resources needed for operations, investments, or growth.

Key priority areas

The Government of Uganda has identified four priority areas to address its socio-economic challenges and accelerate national development. These focus areas align with the country's development agenda and aim to leverage opportunities in strategic sectors for sustainable growth in the four priority areas (See Figure 3).

Figure 3: Key priority areas for 4IR and AI in Uganda
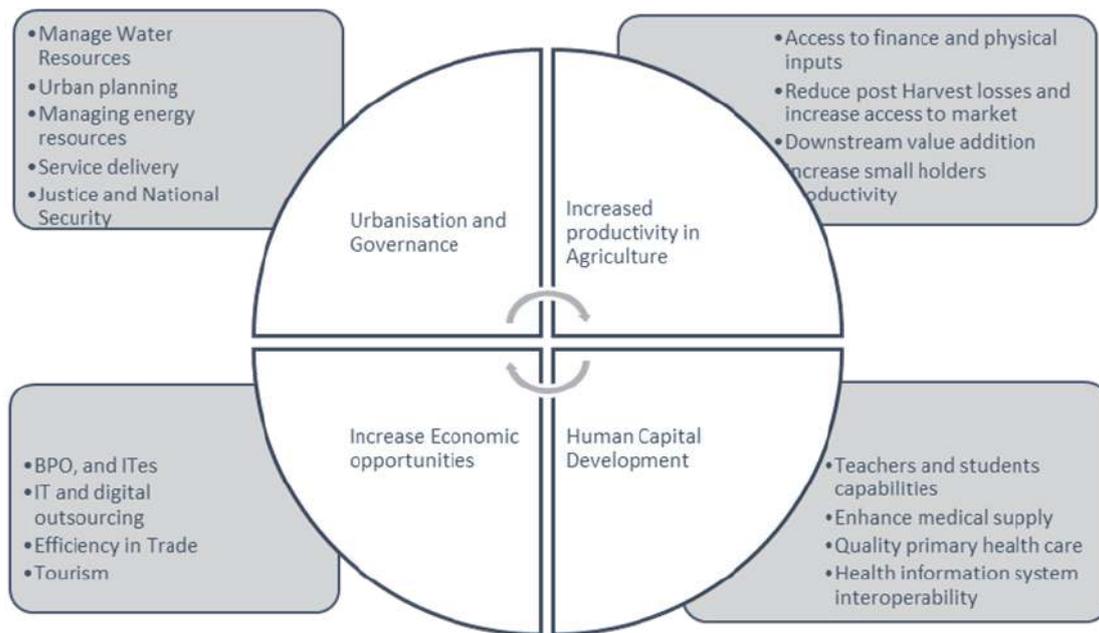
Source: Uganda National 4IR Strategy, 2020.

a) Increased productivity in agriculture with aim to increase GDP output by 2 per cent annually.

b) Human capita development to improve access to education and healthcare, aiming to raise school survival rates by 50 per cent and increase life expectancy by two years.

c) Increase economic opportunity through increased access to digitally traded services and enhance supply chain to create 300 000 new earning opportunities by 2040.

d) Urbanization and governance by using 4IR to manage pressures on urban settlements by extending and delivering critical urban services.

1.1   Objective and purpose

The main objective and purpose of the assignment is to conduct a national AI landscape assessment and propose interventions to harness the economic and social benefits of AI in Uganda while minimizing its potential negative effects.

The specific objectives of this assignment were to:

a)   Undertake a baseline survey of Uganda's current policies, regulations, standards, human resources, stakeholders and underlying ICT infrastructure for AI technology and services. Identify gaps and make recommendations.

b)   Run stakeholder consultations to identify challenges faced by key public and private actors in AI ecosystem, including but not limited to research and development, education, governance, marketing, and deployment, mapping also the AI stakeholders in Uganda across the value chain.

c)   Performing a benchmarking study of three countries including at least two similar economies that have made significant strides in creating an enabling environment providing supportive infrastructure for AI deployment and use.

d)   Assess the availability and extent of readiness of supportive infrastructure for the deployment of AI in the delivery of e-services by the government and evaluate the existing skills in AI development, deployment and use in government ministries, agencies and departments.

e)   Develop a proposal for an AI risk management framework for the country.

The objectives were achieved, and they form the basis of this report.

1.2   Stakeholders in the AI ecosystem in Uganda

The AI ecosystem is a complex and dynamic network involving various stakeholders who contribute to the development, deployment, regulation, and utilization of AI technologies. By recognizing and engaging these stakeholders, the AI ecosystem can foster collaboration, innovation, and sustainable development while addressing societal and ethical challenges.

The stakeholder groups are as follows:

a)   Regulators: Institutions such as the National Information Technology Authority - Uganda (NITA-U), the Uganda Communications Commission (UCC), and the Bank of Uganda (BoU), which oversee compliance and governance within their respective domains.

b)   Government ministries: Key ministries such as the Ministry of ICT and National Guidance, which provide strategic and technical leadership, coordinate policy efforts, and advocate for ICT sector development.

c)   Academia and research institutions: Universities and research bodies such as Makerere University that drive innovation and build the human capital necessary for advancing AI technologies.

d)   Private sector: Industry leaders, startups, and entrepreneurs contributing to the development and commercialization of AI-driven solutions such as MTN and Stanbic Uganda.

e)   Civil society and advocacy groups: Organizations that represent the interests of various societal groups, ensuring inclusivity and advocating for ethical AI practices such as Women of Uganda Network (WOUGNET).

f)   End users and communities: Beneficiaries of AI technologies, whose insights and experiences provide valuable feedback on usability and impact.

g) International collaborators and partners: Global stakeholders such as ITU offering technical expertise, funding, and best practices to support Uganda's AI ecosystem.

Selected key stakeholders in the Uganda AI ecosystem

To gain a holistic understanding of the challenges and opportunities in the Uganda's AI ecosystem, a diverse range of key public and private actors participated in the study based on their strategic roles in various sectors where AI could have significant impact. The stakeholders that participated in the study were as follows:

a) Ministry of Lands, Housing, and Urban Development: Involved in discussions around using AI for land management, urban planning, and mapping services.

b) Ministry of Energy and Mineral Development: Consulted to understand the potential of AI in optimizing energy production, distribution, and consumption.

c) Ministry of Works and Transport: Focused on exploring AI applications in traffic management, transport logistics, and infrastructure maintenance.

d) Kampala Capital City Authority (KCCA): Engaged to assess how AI can enhance urban governance, public service delivery, and smart city initiatives.

e) Ministry of Health: Consulted to explore the use of AI in improving healthcare delivery, disease prediction, diagnostics, and patient management.

f) Bank of Uganda (BoU): Engaged to understand the potential of AI in enhancing financial inclusion, fraud detection, and policy analysis in the banking sector.

g) Ministry of Agriculture, Animal Industry, and Fisheries: Involved in discussions on the use of AI for precision farming, crop monitoring, and pest control.

h) National Planning Authority: Consulted to discuss strategic policy planning and the integration of AI in national development frameworks.

i) Uganda Communications Commission (UCC): Involved to explore the regulatory environment for AI, data privacy, and digital transformation.

j) National Information Technology Authority - Uganda (NITA-U): Consulted to discuss the national ICT infrastructure, data management policies, and support for AI innovations.

k) Ministry of Internal Affairs: Engaged to explore AI applications in maintenance of security and stability.

l) Ministry of Finance, Planning and Economic Development where AI could be applied for macro-economic forecasting allowing for better fiscal policy decisions.

m) Stanbic Bank Uganda: Engaged as a key player in the financial sector to understand how AI can transform banking services, customer experience, and risk management.

n) Uganda Revenue Authority where AI could be used in assessments and collection of taxes in Uganda.

o) MTN Uganda and Airtel Uganda – Explore use of AI in customer care, detecting and preventing fraudulent activities within telecommunication networks.

The Ministry of Internal Affairs and Airtel Uganda however, participated partially only in the stakeholder consultation while UCC and NITA-U information on their websites and in reports were used.

2   Methodology

This study employed a mixed-method approach to fully understand the interventions that the Government of Uganda needs to make to ensure that the country can harness the economic and social benefits of AI while minimizing its potential negative effects. The approaches included desk reviews, baseline survey, webinar and key informant interactions.

2.1   Desk review

For purposes of triangulation, identifying key measures and parameters in this study, a variety of documents (Data Protection and Privacy Act, 2019; Uganda National 4IR Strategy, 2020; Republic of Uganda, NDP III, 2020; Data Protection and Privacy Regulations, 2021; The Computer Misuse (Amendment) Act, 2022) related to Uganda's AI and digital transformation efforts were reviewed.

It involved reviews of the national AI and ICT policies, strategies, and regulations related to initiatives for implementation of AI and 4IR technologies in respective organizations to understand the government vision for AI and how well it aligns with the actual capabilities and need to create an enabling environment providing supportive infrastructure for AI deployment and use. The documents reviewed helped ground findings on existing policies and frameworks, ensuring that the recommendations we provided are both realistic and aligned with Uganda's broader digital transformation goals. Existing AI training programmes designed to help public officers develop their AI skills were reviewed. Examined reports on Uganda's ICT infrastructure, including the national data transmission backbone infrastructure, Internet connectivity, data storage capabilities, and cloud services.

The review helped to identify countries with similar economies that have made significant strides in creating an enabling environment providing supportive infrastructure for AI deployment and use and another country which is AI ready with robust AI infrastructure that supports seamless development, deployment, and operation of AI technologies.

This information from desk review not only helped to understand the present status of the AI ecosystem and available technologies but also assisted to prepare the data collection tools. Collection of data through various means was done with the intention of triangulating information to complement and generate meaningful conclusion about the AI landscape of Uganda from the study.

2.2   Baseline survey

In the survey a structured questionnaire with closed and open-ended questions was administered to collect the needed data. The data collection process made use of key informant interactions during which qualitative data from selected Uganda ministries, departments, and agencies (MDAs) and private institutions were collected and analysed. This baseline survey was critical in confirming or reaffirming some of the assumptions and data already available.

Survey scope and respondents

The baseline survey was conducted in the government of Uganda MDAs and private institutions as indicated in section 1.4 In all the organizations, focal people were identified by the respective

institutions and were responsible for organizing other team members who participated in the survey.

Sampling technique

Simple non-probabilistic sampling technique known as purposive sampling which refers to intentionally selecting participants based on their characteristics, knowledge and experiences was used. This is because MDAs and private institutions fostering initiatives to use AI and 4IR technologies were known by the Ministry of ICT and National Guidance making it easy for them to make the selection.

Sample frame and sample size

The sampling frame for the baseline survey included potential MDAs (13) and private institutions (3) with supportive digital infrastructure for e-services including those that leverages AI and related 4IR technologies. However, not all responded to the request to undertake the survey except 10 MDAs and two private institutions that participated in the survey. The sampling frame had included research institutions and regulators such as NITA-U, UCC and BoU which are significant stakeholders in the emerging AI technology ecosystem however, NITA-U and UCC did not participate in the baseline survey.

Development and review of the research tool

A structured questionnaire was developed for collection of data from the respondents during formal meeting and interactions. The questionnaire was prepared after reviewing and studying existing literature and research materials prior to data collection. The questionnaire addressed the following areas: AI policies, legal and regulatory frameworks, AI standards and regulations, hardware and software infrastructure, AI applications, data management and governance; and AI skills and capacity development as in Appendix 1.

Data collection

Meetings were held with respective MDAs and private institutions to discuss AI readiness in their institutions. A questionnaire was administered and responses captured. Instructions on how to complete the questionnaire was provided and respondents were assured of the confidentiality of their responses.

Data preparation

The collected data was cleaned by identifying and fixing inaccurate, incomplete or irrelevant data in the dataset. The cleaning and processing were to ensure quality of the dataset to be entered and thereafter analysed.

Data entry

The baseline survey data was coded for open ended questions and later entered into the Statistical Package for the Social Sciences (SPSS 16.0) which is a software developed by IBM for data management and analysis. MS Excel was used for drawing graphs.

Data analysis

Data analysis was done using SPSS v16. Descriptive statistics was used for data analysis for this study. Variables were measured by frequency and percentages as in the output generated from

the analysis. The analysed information was then presented in tabular and graphical form in the report for ease of reference.

Reporting

The data was summarized highlighting key insights such as AI use, skills, infrastructure, policies, legal and regulatory frameworks, gaps, and potential areas of growth. The findings were as presented in this report, using visual aids such as graphs and charts to illustrate trends. Thereafter, recommendations based on the findings were suggested.

2.3   Stakeholder consultation

The consultation process comprised interviews, guided questionnaires, and a webinar, offering valuable insights into challenges faced by key public and private stakeholders within Uganda's AI ecosystem and the opportunities for leveraging AI benefits.

The stakeholders comprised of regulators such as BoU, users such as MDAs, private organizations such as MTN and Ministry of ICT and National Guidance which provide strategic and technical leadership, overall coordination, support and advocacy on all matters of policy, legal and regulatory framework and strategy for the ICT sector. The webinar was to allow a two-way communication between the host and audience, which was an ideal observational qualitative data source. This method enables free conversation while sharing insights. The topics of discussion were tailored to reflect the specific context and role of the stakeholder, ensuring relevance and depth in the responses.

In this approach, participants were to explore themes of interest further, delve into underlying issues, and gain nuanced perspectives on the challenges and opportunities within Uganda's AI ecosystem. This diverse stakeholder engagement ensured that the study captured a broad spectrum of perspectives, ranging from policymakers and regulators to industry leaders and technology implementers. By integrating insights from both public and private actors, the methodology enabled a nuanced understanding of the barriers and drivers shaping Uganda's AI ecosystem. This comprehensive approach ensured the recommendations are practical, inclusive, and grounded in the realities faced by various stakeholders.

2.4   Benchmarking

The benchmarking study was carried out on countries that share economic similarities with Uganda and have made significant strides in creating an enabling environment providing supportive infrastructure for AI deployment and use; and one other with well-developed AI regulatory frameworks, infrastructure and skills to ensure the findings are relevant and adaptable. Experiences of these countries were examined with the aim of identifying the best practices and key strategies that Uganda can adopt to facilitate AI deployment, foster innovation, ensure ethical governance, manage risks and build a resilient digital ecosystem.

The selection process adopted the 2023 AI Readiness Index as a guiding framework to establish a comprehensive basis for benchmarking AI readiness status. This index assesses a country's preparedness to leverage AI for public service delivery, emphasizing AI as a driver for economic and social development. Other tools whose strength were leveraged are the UNESCO Readiness Assessment Methodology (RAM) that assist countries to identify their AI status and readiness trajectory and UNDP AI Readiness Assessment (AIRA) that help governments understand the

AI landscape in their country and assess their level of expertise across sectors. The interactive Transforming Data With Intelligence (TDWI) AI Readiness Assessment, which has questions across five categories that form the dimensions of the TDWI AI Readiness Model, was leveraged. This supported interesting assessment in the areas of organizational readiness, data readiness, skills readiness, operational readiness and governance readiness.

The readiness of each country is evaluated across five core pillars:

a) Government capability: Measures the strength of government frameworks, policy initiatives, and support for AI-driven solutions.

b) Technology sector: Examines the maturity of the technology sector, including the level of innovation and support for AI development and implementation.

c) Data and infrastructure: Evaluates data accessibility, digital infrastructure, and the technological backbone required to support AI deployment.

d) Education and skills: This assesses the capacity of the workforce and educational system to produce the necessary skills for AI development and implementation.

e) Social and cultural: Considers factors relevant for ethical development and deployment of AI systems including inclusiveness and social and cultural diversity, public awareness and values relevant to scaling up of ethical AI solutions.

2.5   Ethical consideration

Ethical practices in data collection were observed. Informed consent of the participants was obtained before proceeding with data collection.

2.6   Limitations

This AI landscape assessment did not happen without limitations. The following were the limitations: For the assessment done through the baseline survey, stakeholder consultation and interview, the time to prepare respondents for data collection was limited therefore, it was not easy for the institution to assemble respondents, and other divergent views may have been missed. There were fewer subject-matter specialists engaged during the survey, which may have affected the insights of the responses that could have been extracted. However, those who participated were key and their responses representative. The study had many dimensions to be looked at within a short time.

3   Baseline survey

A baseline survey to assess Uganda's current policies, regulations, standards, human resources, stakeholders and underlying ICT infrastructure for AI technology and services to identify gaps was conducted: Sixteen organizations (13 MDAs and 3 private organizations) were selected by the Ministry of ICT and National Guidance to participate in this assessment in total. In the assessment through baseline twelve organizations (75%) participated (10 MDAs and 2 private organizations) while in the stakeholder engagement fourteen organizations (87.5%) participated (11 MDAs and 3 private organizations) which is representative. Recommendations are presented in section 7.

3.1   AI policies, legal and regulatory frameworks

Most of the institutions, approximately 83.3 per cent who participated in the baseline survey are government institutions with 16.7 per cent being private institutions such as Stanbic Bank and MTN. This implies that most of the findings reflected can be generalized in MDAs. The senior and principal officers in MDAs and private institutions who were the focal persons in the baseline survey constituted 45.5 per cent while AI professionals were approximately 27.3 per cent of those who participated in the survey. Policy makers and IT technical resources were 18.2 per cent each respectively. The principal and senior officers form a good base to set tactical insight into how organizations they represent should strategies for the adoption of AI technology while the policy-makers set the AI implementation strategy. Organizations are beginning to have data scientists and AI professionals as part of the human resources which the Ministry of ICT and National Guidance could use as champions in supporting AI ecosystem buildup. As shown in Figure 4 83 per cent of institutions are not aware of any national AI policy, which is the current situation.

Figure 4: Awareness about national AI policy
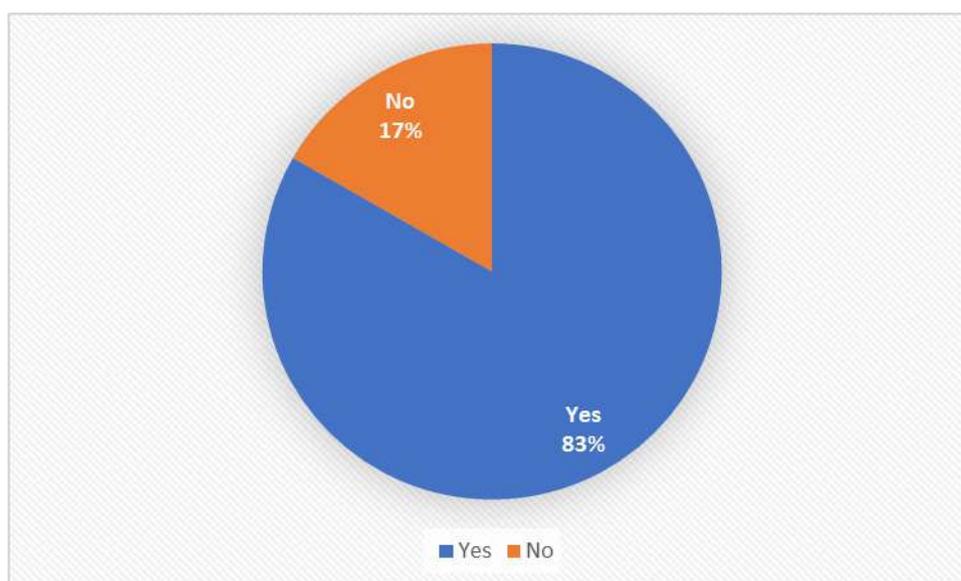
Source: Project research, 2024.

An AI policy which is missing currently would be used as a base for setting up a framework for responsible and effective AI use in Uganda public and private organizations. This will ensure compliance with consistent and approved behaviour in AI tools by all AI actors.

The respondents were probed further to understand if there are any laws or regulatory frameworks related to AI usage and development in their organizations. The study established that there are no laws or regulatory frameworks (50%) in place while other respondents (33.3%) claim they are under development. The framework mentioned (16.7%) to be in existence related to AI adoption and cyber risk management.

The majority (50%) stated that the national AI policy impact positively on AI innovation and deployment. However, 33.3 per cent claim there is no impact as shown in Figure 5 possibly because the ecosystem does not exist in their organizations.

Figure 5: National policy impact on AI innovation
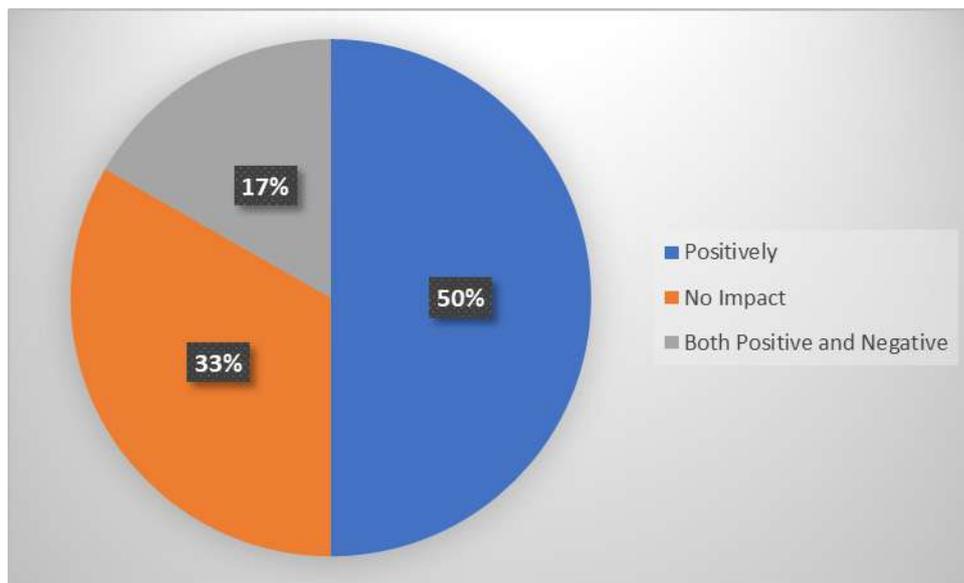
Source: Project research, 2024.

The positive impact is that it encourages research and development (36.4%) as well as promoting ethical AI use and risk mitigation (36.4%). Some respondents, however, argue that the unregulated AI space (18.2%) allows for innovations. The transformative power of AI will enhance strategic decision-making capability and improve efficiency as it will allow for rapid identification and resolution of complex problems. Furthermore, in the private sector AI technology will increase the speed of innovation, reduce operational costs and time-to-market.

On the impact of legal and regulatory frameworks, 41.7 per cent stated that it positively impacts AI innovation and deployment in the various sectors, however 41.7 per cent do not see any impacts. The remainder 16.7 per cent stated that they impact innovation and deployment both positively and negatively. This noticeable positive impact of AI should be harnessed for the socio-economic benefits of the country. The positive impacts are shown in Figure 6.

Figure 6: Impact of legal and regulatory framework
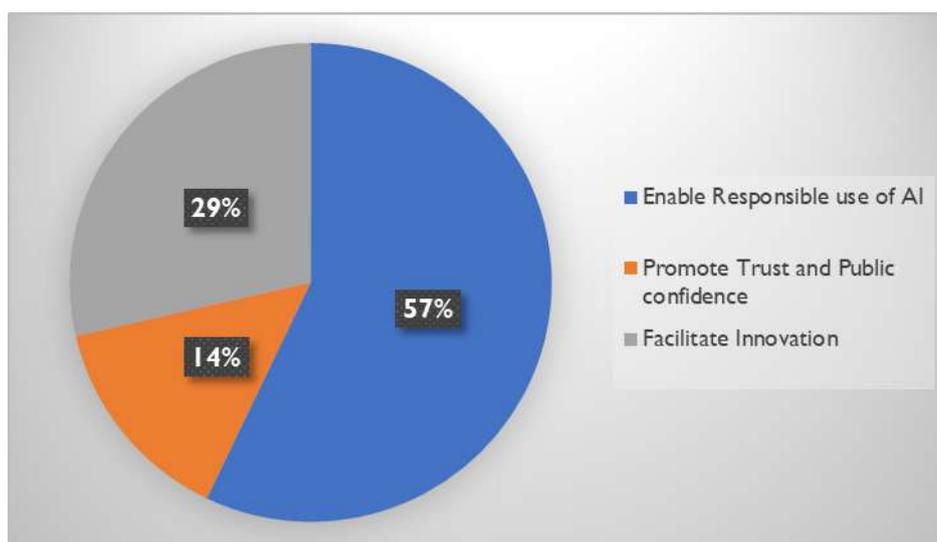
Source: Project research, 2024.

The positive impacts registered influence adoption of AI technology in the public and private sectors organizations. The legal and regulatory frameworks support the responsible use of AI, foster innovation, and build trust and public confidence by providing a structured approach to addressing the ethical, societal, security and legal challenges introduced by AI.

The existing legal frameworks/initiatives in Uganda that address AI related risks are presented in Table 1.

Table 1: Existing legal frameworks/initiatives that address AI related risks

Legal frameworks/initiatives	Response (%)
Data protection and privacy	45.5
AI ethics and fairness	9.1
Intellectual property rights in AI	13.6
AI Accountability and liability	9.1
Regulation and AI-based decisions	9.1
Human rights in the context of AI	9.1
Cyber laws in transactions	4.5

The respondents (45.5%) raised issues of data privacy and protection as the biggest concern within MDAs due to sensitivity of data held which can raise legal concerns in the event of privacy violation. Intellectual property rights in AI was the second most raised issue (13 .6%) and this relates to ownership, protection, and ethical use of intellectual property. AI ethics and fairness (9.1%) together with human rights in the context of AI (9.1%) are of some concern and this relates to deployment of AI systems across sectors such as healthcare, finance, and employment due to potential for bias, discrimination, and violations of fundamental human rights. Accountability and liability (9.1%) together with regulation and AI based decision (9.1%) were of concern due to transparency, fairness, and ethical implications which are essential for creating a future where

AI-based decision-making is aligned with societal values and human rights. Cyber laws (4.5%) which deal with legal frameworks and regulations designed to address the intersection of AI and cybersecurity were of less concern to the respondents possibly because of lack of awareness.

The legal and regulatory frameworks in Uganda significantly addresses most of the risk associated with AI ecosystem development and deployment in Uganda however, there is need for policies to address other social and societal risks such as job losses. Lack of AI policy (25%) is perceived as the biggest gap in the current initiative to develop legal and regulatory framework around AI development and deployment as shown in Figure 7.

Figure 7: Gaps in current legal and regulatory initiatives
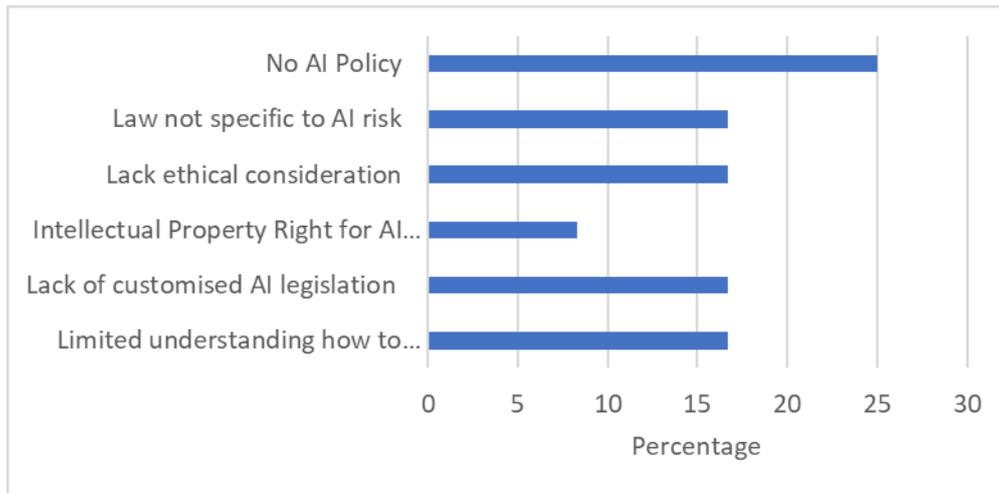
Source: Project research, 2024.

An interesting revelation is that there is limited understanding of AI (16.7%) to regulate its development and deployment. This implies that the government should invest in sensitization and training on AI to develop comprehensive AI policy, legal and regulatory framework and for the population to appreciate this technology. Areas that different institutions would want them prioritized in the new regulations in Uganda's AI ecosystem are presented in Figure 8.

Figure 8: Areas to prioritize in potential new regulations
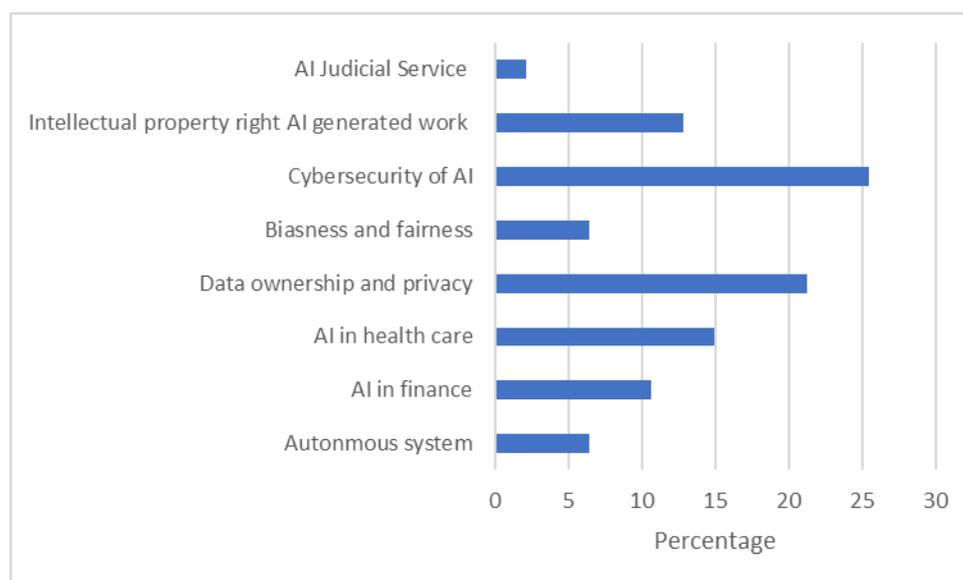
Source: Project research, 2024.

The major areas to be prioritized in the new regulation include cybersecurity (25%), Data ownership and privacy (21.3%), AI in health (14.9%), Intellectual property right AI generated work (12%) in the Uganda AI ecosystem, AI in finance (10.6), bias and fairness (6.4%) and autonomous system (6.4%) and AI in judicial service (2.1%). Ethical issues relate to bias, fairness, transparency, accountability, security and explainability of AI models is to ensure responsible use of AI.

3.2   AI Standards, policies and regulations

Approximately 66.7 per cent of organizations do not adhere to international AI standards such as ISO/IEC 42001:23, ISO/IEC 23052:2022 and ISO/IEC 23894:2023 with 25 per cent stating that the adoption of AI is under development. This implies a low intake of AI solutions now. Majority of the organizations (81.8%) do not have sector-specific regulations that they follow while 9.1 per cent stated that have and under development respectively. Nearly 57.1 per cent of the organizations use internal AI ethics committee to ensure ethical AI development and deployment in addition to using AI ethical guidelines (28.6%) while 14.3 per cent use digital health committees which can still be regarded as internal committee. Most organizations (80%) do not have mechanisms in place to address algorithmic bias with 10 per cent having it in place and 10 per cent under development. The challenges organizations face in adhering to AI standards include lack of regulatory framework (33.3%), lack of AI skills (33.3%) and bureaucratic internal approval process (33.3%). This is probability because AI is a new field which has not been explored and appreciated fully in enhancing operations and service delivery. This is supported by the fact that most organizations (63.6%) do not know whether there are efforts to harmonize AI standards and policies, however 36.4 per cent claim there are policies in place. Efforts that are available to harmonize AI standards and policies are as presented in Table 2.

Table 2: Efforts to harmonize AI standards and policies

Efforts	Response (%)
Africa CDC initiative	12.5
African Union initiative on AI policy	37.5
Smart Africa Alliance	12.5
Africa Centre for AI and Digital Technology	12.5
Inter University Council	12.5
EA Science and Technology Commission	12.5

The African Union AI initiative (37.5%) is committed to leveraging AI as a transformative tool for economic growth, social equity, and sustainable development as the African Union aims to position Africa as an integral participant in the AI revolution. Africa CDC initiative (12.5%) which strengthens the capacity and capability of Africa's public health institutions as well as partnerships to detect and respond quickly and effectively to disease threats and outbreaks, based on data-driven interventions uses AI for disease surveillance, diagnostics, and outbreak response, Smart Africa Alliance (12.5%) with a goal to advance Africa's digital agenda and accelerate sustainable socio-economic development by 2030, Africa Centre for AI and Digital Technology (12.5%) is interested in AI development and supporting AI policies in Africa for inclusion of women and youth in the digital technology, Inter-University Council (12.5%) encourages AI education, research, and university-industry partnerships while the East African Science and Technology Commission (12.5%) is the East African Community (EAC) agency mandated to promote and coordinate the development, management and application of science, technology and innovation (STI) activities in the region.

Adhering to harmonized standards will establish a presumption of conformity for high-risk AI applications and services, providing assurance that they meet the level of confidence and requirements of the proposed regulations. This, in turn, creates strong incentives for industry to align with these standards.

3.3   Hardware and infrastructure for AI

Approximately 52 per cent of the institutions are currently using standard servers followed by 19 per cent using high performance computing clusters, 14 per cent graphics processing units, 10 per cent cloud platform and edge computing devices (5%) as shown in Figure 9.

Figure 9: Available hardware infrastructure
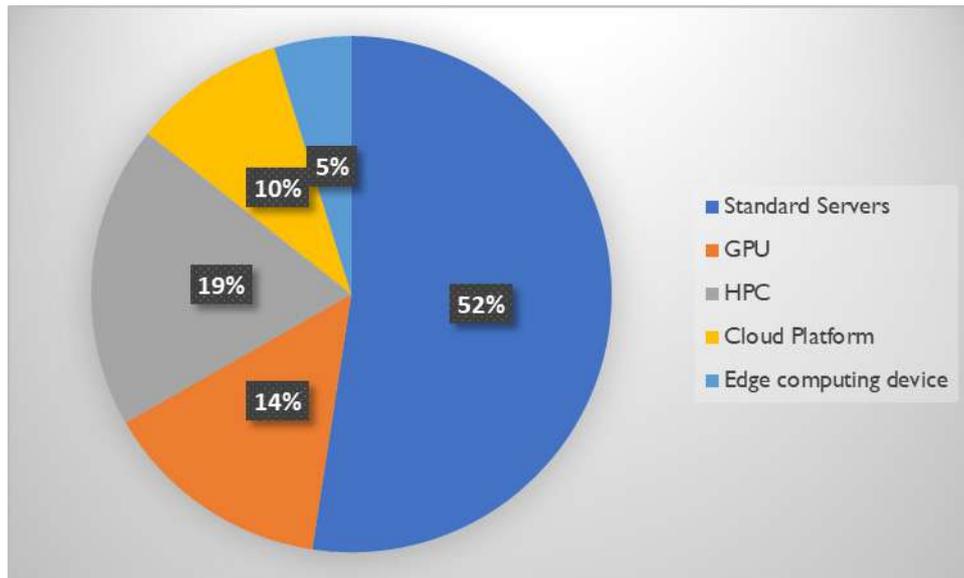
Source: Project research, 2024.

Standard servers may not be sufficient for many AI applications as they are CPU based, particularly when the tasks involve large-scale or complex AI model training, due to limitations in computational power. There is noticeable acquisition of GPUs and high performance computing (HPC) in the private sector which are specialized for parallel computing and can support AI development. This finding reveals that there is insufficient hardware to support the development and deployment of AI solutions, especially in MDAs. Scalability and futureproofing are critical aspects of AI hardware, considering the rapidly evolving landscape of AI technology. This implies that there should be in place hardware with sufficient capacity and characteristics such as low latency, high throughput and efficient to provide robust and efficient platforms for AI applications.

The main challenge with the AI hardware infrastructure is the high cost of equipment (50%) followed by a lack of skilled personnel to maintain the hardware (20%) as shown in Figure 10.

Figure 10: Challenge with AI infrastructure
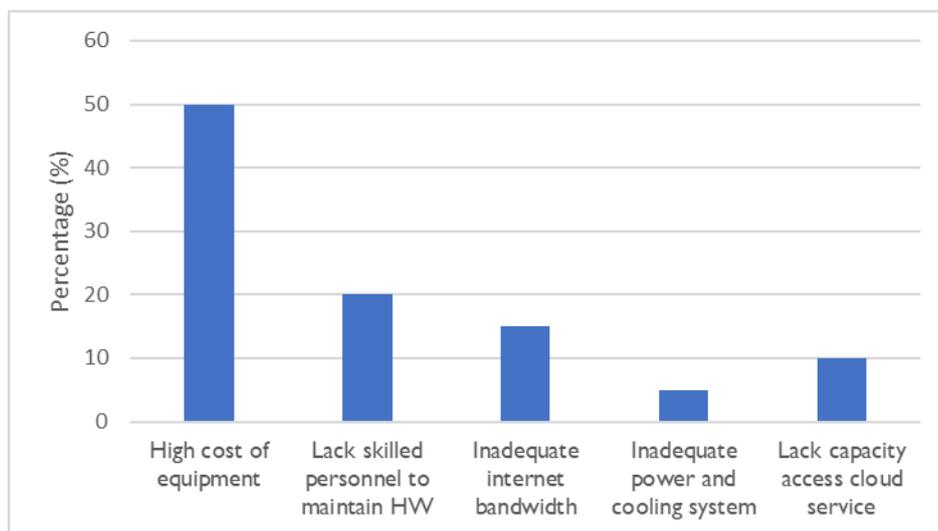
Source: Project research, 2024.

Most of the institutions currently use local data centres (60%) with 40% using both local and leveraging international cloud service. For now, 87.5 per cent of the AI computational need is being met by using the cloud infrastructure. The increased use of AI workload demands significant computational power, storage, and efficient data management. This implies that serious investment in the hardware infrastructure should be committed to support the establishment of an AI ecosystem. The hardware investments that would significantly boost AI development are as shown in Figure 11.

Figure 11: Infrastructure to boost AI development
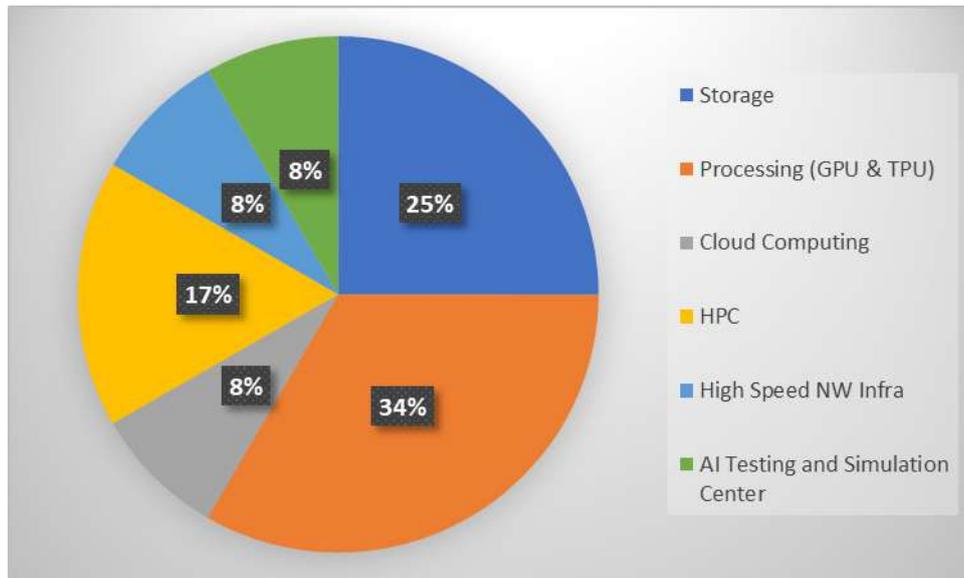
Source: Project research, 2024.

Using TPU (Tensor Processing Unit) and GPU (Graphics Processing Unit) for high processing and efficiency requires ample storage as depicted in Figure 11. Users of AI in Uganda should invest in such infrastructure. Due to the cost being high, a centralized national infrastructure which can be shared could be established at a selected national AI initiative office.

In the knowledge and information sharing sphere, noticeable efforts are being steered by organizations such as the Research and Education Network for Uganda (RENU) which a not-for-profit organization that brings together public and private research and higher education institutions in Uganda whose core mission is to provide a better education and research environment geared towards the development of the country. The network is a cooperatively owned and community-driven service provider that helps to facilitate research and education networking among its member institutions through interconnecting them with other research and education networks as well as to the commercial Internet worldwide, thereby overcoming the traditionally high costs of information and knowledge sharing and exchange. This initiative is more on facilitating information and knowledge sharing and exchange thereby enabling seamless collaboration among them and their peers nationally and globally but does not fully solve the need for an AI infrastructure.

3.3.1 Current data centre infrastructure

Uganda has made some stride in building a centralized hardware ecosystem, but there are still areas that need improvement to fully support the nation's AI initiatives. Few applications from MDAs are deployed at the Uganda National Data Centre at NITA-U. The data centre was established with a view of centralizing government data centres and minimizing the cost of building various data centres in MDAs.

While the National Data Centre at NITA U may serve general IT needs, its infrastructure and resources might be insufficient for AI development and deployment due to factors such as lack of specialized hardware, limited scalability, insufficient storage and memory, and potential network limitations. To effectively support AI, the data centre would need to invest in high-performance hardware (e.g. GPUs and TPUs), ensure scalability, provide sufficient storage and bandwidth, and integrate with cutting-edge AI tools and services. Furthermore, a strong ecosystem of talent, security measures, and compliance would be required to make it a suitable environment for AI research, development and deployment.

The National Data Centre currently provides some centralized hosting services, disaster recovery services and other data centre services for government applications and data.

Data centre services being provided:

a) Platform as a service (PAAS).

b) Infrastructure as a service (IAAS).

c) Software as a service (SAAS).

d) Disaster recovery as a service and backup as a service (BAAS).

The MDAs enrolled into the data centre have the following benefits.

a) Hi-tech security:

  – Multiple layers of hardened physical security.

  – Closed-circuit television (CCTV) surveillance.

  – Instant SMS Alerts to predefined personnel.

  – Biometric access and code protected entry.

  – Access to the data centre only by designated and authorized staff.

  – Fireproof door.

  – 24x7x365 security presence.

  – Visitors are required to sign-in/sign-out, have photo ID and must be always escorted by data centre personnel.

b) Fully redundant, data grade power and air conditioning at the data centre:

  – Direct AC power 220 - 240V.

  – Two generators, one with 200KVA backup and the other 250KVA backup.

  – Two uninterruptible power supply systems (60 KVA and 60 KVA redundant).

  – Fully redundant precision-controlled air-conditioned environment.

c) NITA Data Centre Ltd Managed Services:

-   Monitoring of Virtualized infrastructure to host production sites for applications and databases.

-   Provision of required infrastructure to host production sites such as CPU, RAM and storage.

-   Provision of required platform to host production sites such as Windows and Linux.

d) Dedicated infrastructure:

    -   Dedicated virtual servers with required specifications.

    -   Dedicated virtualized storage system for client data.

    -   Dedicated Windows based platform for client requirements.

e) Data recovery site equipment - storage for replication of data and application servers:

    -   All the data from the primary site i.e. from NITA-data centre is maintained solely by the client and NITA-U does not interfere in any installations of software or any functionality regarding client data.

    -   The client provides all the equipment for connectivity of primary site as well as data recovery site (in case of any replication happening between both the sites).

f) Data security measures

    -   Database and application servers are password protected by the customer.

    -   Client provides NITA-U Data Centre with full details of their officials authorized to get access to the disaster recovery site.

    -   Clients may decide to change the authorities from time to time, but fully at the customer's discretion. It is responsibility of the Client to keep NITA-U updated of any such change.

    -   The client maintains the schedule of checking their application on a regular basis as NITA-U will not be responsible for application functionality.

    -   NITA-U is responsible for providing necessary hardware and software for platform as a service only and any other additional software are accommodated by the client.

This is a starting point in AI hardware infrastructure for development and deployment of AI solutions although it is not sufficient. To effectively boost AI development and deployment in Uganda MDAs, the government would need to make targeted investments in high performance computing (HPC) infrastructure.

3.3.2   The national data transmission backbone infrastructure

The National Data Transmission Backbone infrastructure is undergoing implementation with the aim of connecting all major towns onto a fibre-optic cable-based network and to connect ministries and government departments onto the e-Government network. The NBI, implemented as the primary vehicle for secure, high-speed data, Internet, and voice services across government entities, has consistently enhanced communication, increased government efficiency, and improved service delivery. To date, NITA-U has successfully completed four phases of the NBI/e-Government Infrastructure Project (NBI/EGI) laying 4 387 kilometres of optical fibre that connects: 53 district headquarters, 11 major border stations, and 1 480 ministries, departments, and agencies (MDAs). Phase V of the NBI has been launched and an additional 5 845 kilometres of optical fibre will be laid, covering 63 more districts across the country as per the NITA-U website. The project includes last-mile connectivity to over 2 800 sites, such as

schools, hospitals, government institutions, parishes, youth centres, and community centres. Furthermore, under this project Wi-Fi coverage will be extended to an additional 1 754 sites nationwide. This extensive network has significantly boosted the efficiency of digital government service delivery and lowered the cost of communication across government institutions.

This is a landmark development in Uganda's quest to enhance its telecommunication framework. This infrastructure provides a robust network for high-speed data transmission across the country, connecting various regions and facilitating efficient communication. The backbone network supports the flow of information necessary for AI applications, enabling real-time data exchange and processing capabilities. By connecting urban centres with remote areas, the backbone infrastructure contributes to bridging the digital divide and supporting initiatives aimed at promoting AI adoption in diverse sectors, including agriculture, health, and education.

Mobile phone penetration in Uganda has rapidly increased to approximately 67.7 per cent, serving as a critical enabler of digital services and applications, including AI solutions. By the end of 2023, Uganda had 3G coverage of 77 per cent, 4G coverage of 31 per cent and quickly moving toward 5G coverage with approximately 50 sites through Airtel Uganda (UCC, 2023). With a significant portion of the population relying on mobile devices for communication, banking, and access to information, the mobile network infrastructure is essential for reaching a broad audience. This high mobile penetration rate supports the deployment of mobile-based AI applications, such as chatbots for customer service, mobile health applications, and data collection tools for research and analysis. Leveraging the existing mobile infrastructure can enhance the delivery of AI-driven services, especially in areas with limited access to traditional Internet connectivity.

With Internet penetration reaching approximately 70 per cent, Uganda has made significant strides in connecting its people to the digital world and this is a good move towards boosting the AI Ecosystem. However, there are still gaps between urban and rural areas. Expanding high-speed Internet, especially in remote regions, is critical to ensuring that AI technologies can benefit everyone across the country.

3.4   AI applications

The AI applications being used most in the different sectors in Uganda as per the baseline survey results are Natural Language Processing (33.3%), predictive analytics (28.6%), computer vision (19%), AI in finance (9.5%) with the rest being AI in health (4.8%) and robotics (4.8%). The NLP supports Chatbots since it parses inputs while generative AI automates the response. The chatbots are like a virtual assistant providing instant, accurate, and personalized responses to citizen queries. This can enhance service delivery since response to citizens queries can be attended to 24/7. Predictive analytics using data, statistics, modelling and AI can predict future outcomes which helps the government to make more effective policy decisions and allocate resources more efficiently.

The sectors which show the greatest AI adoption potential include Finance (18 %), Education (18%), Telecommunication (18%), Transportation (16 %), Agriculture (14%), Energy (12 %), Health (2%) and Judicial (2%). This implies that sectors such as agriculture, finance, education, telecommunication and transport are beginning to take advantage of the opportunities AI could bring. Examples could include its support to manage and analyse large amounts of data quickly, efficiently and accurately, reduce human error, interpret past data to form a reliable picture of future trends, automate certain tasks, thus freeing up time for more creative and strategic initiatives representing a potential gained opportunity for productivity gains.

The greatest barriers to AI adoption are presented in Figure 12.

Figure 12: Barriers to AI adoption
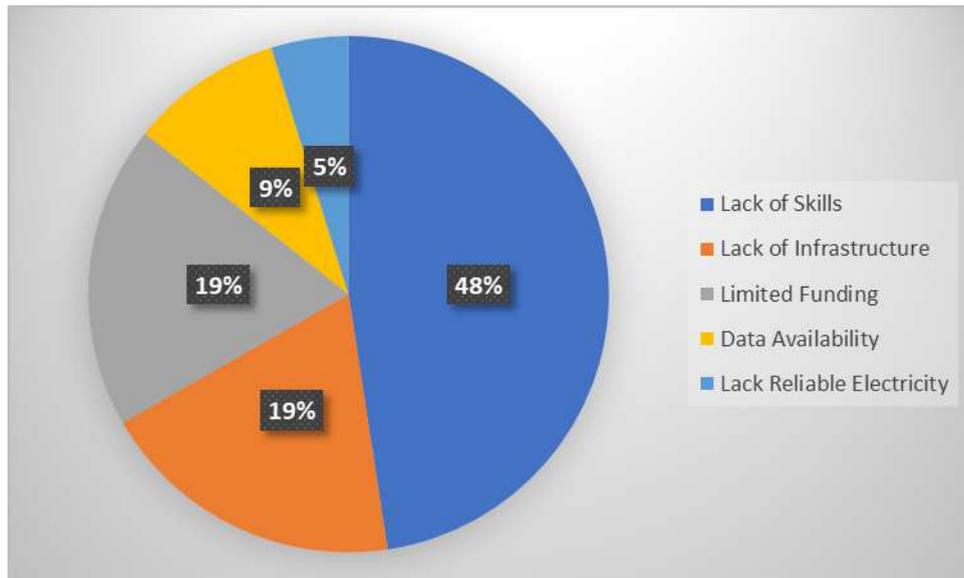
Source: Project research, 2024.

Lack of skills (48%), lack of Infrastructure (19%) and limited funding (19%) stand out as the greatest barrier to AI adoption in Uganda. Skills in AI development and deployment which are technical, analytical and ethical are essential for effectively creating, implementing, and managing AI systems to drive innovation and efficiency. Infrastructure is a critical component of AI development and deployment because it provides the technological foundation required to build, train, deploy, and manage AI systems effectively. Funding facilitates acquisition of resources, tools, and talent necessary to create, implement, and scale AI solutions.

The key benefits perceived in adoption of AI are efficiency in service delivery (36.2%), support in planning (18.1%), proactive risk identification and management (18.1%) and enhanced productivity (13.6%). This improvement in service delivery is by revolutionizing how governments interact with citizens, streamline operations and make data-driven decisions.

Despite knowledge of the benefits of AI, limited initiative exists to harness the advantages of the AI stack possibly because of issues such as lack of clear AI policy, skills needed to fully use these advanced tools and lack of in-house or third-party support. While AI platforms from companies such as Microsoft, IBM, and Google are powerful, they can be very expensive. Most government institutions in Uganda will find it difficult to afford these proprietary solutions due to limited budget, which limits access to their advanced features, such as real-time data processing and AI model training platforms. The issues of data privacy and protection still raise concerns within MDAs about the privacy and security of sensitive data much as there is a data protection and privacy law in Uganda. Lack of interoperability which makes it difficult to share and use data across departments. This would have enhanced harnessing of the socio-economic benefits through the available data.

3.5   Data management and governance

Most organizations (58.3%) intimated that they store large datasets while 25 per cent do not and 8.3 per cent don't know or partially store respectively. The types of data storage systems being used are as shown in Figure 13.

Figure 13: Types of data storage systems
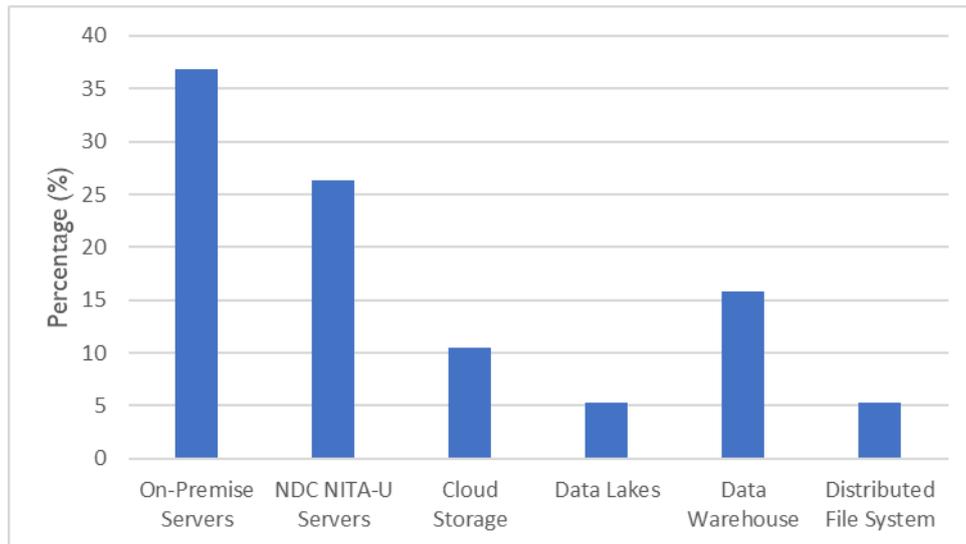
Source: Project research, 2024.

Most of the institutions use on-premises servers (36.8%) followed by hosting at the National Data Centre – NITA U (26.3%), Data warehouse (16.8%) and cloud storage (10.5%). Data storage is a critical aspect of AI development and deployment, as it directly impacts the performance, scalability, security, and efficiency of AI systems. Suitable storage system along with optimized software algorithms that enable rapid data retrieval reduces latency and accelerates the training and inference phases of AI models.

Most organizations as shown in Figure 14 are compliant with the data protection and privacy law (24.4%) which was enacted in 2019, implement internal access control policies (24.4%), data encryption (22.2%), regular data audits (15.6%) and data anonymization (13.3%).

Figure 14: Data governance compliance
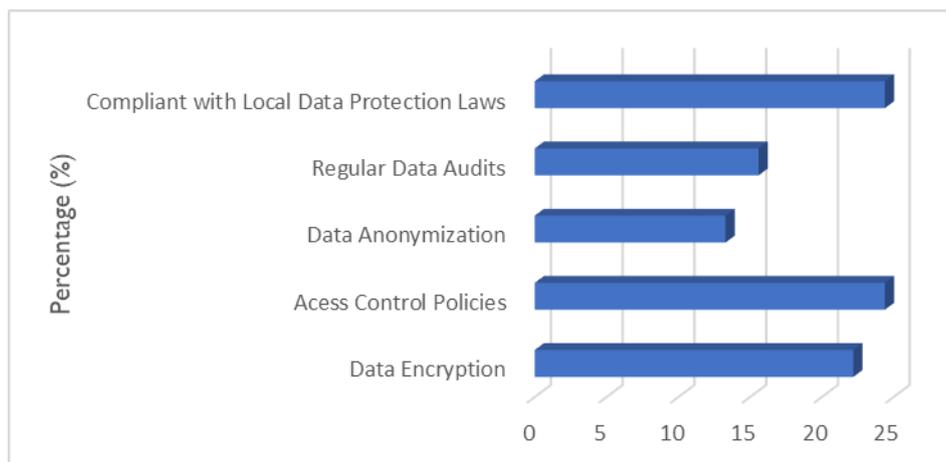
Source: Project research, 2024.

Data governance is critical in AI development and deployment to ensure responsible and effective use of data. It encompasses the processes, policies, and standards that manage the availability, usability, integrity, and security of data in AI systems.

On data management, institutions face challenges of data quality (25%), lack of a centralized data repository (25%), lack of skills to manage the data (12.5%), lack of tools (12,5%), lack of infrastructure (12.5%) and lack of data availability (12.5%). Data quality affects the performance, reliability, and ethical integrity of AI systems. High-quality data enables AI models to make accurate predictions and decisions, while poor-quality data can lead to biased, unreliable, or even harmful outcomes. Having a centralized data repository enables seamless data integration, accessibility, and management. The performance and reliability of AI models depend on timely and consistent access to quality data. It is important therefore that institutions should have ready and accessible data when needed for training, testing, and deploying AI models.

On the data protection and privacy law, 81.8 per cent of respondents stated that it is important while 18.2 per cent believe it is not important. AI systems rely heavily on vast amounts of data to function effectively and ensure that this data is handled responsibly, safeguards individuals' rights, fosters trust, and mitigates risks. Knowledge of the importance of the law on data protection and privacy is an accelerator to the adoption of an AI ecosystem. A majority of the respondents (90%) are of the view that there is need for new or updated governance frameworks for data management and governance specifically tailored to AI.

The challenges highlighted create opportunities to:

- Invest in high-performance computing infrastructure and expand the capacity of the National Data Centre at NITA-U to efficiently manage large datasets for AI benefits. This investment will improve data storage, processing, and analysis capabilities, creating a base for leveraging AI technologies and realizing their full potential.

- Develop a comprehensive policy with clear guidelines for data collection, storage, sharing, and protection to strengthen accountability, ensure ethical data usage, and build trust among stakeholders.

- Strengthen enforcement of data protection and privacy law to reduce risks of data breaches and builds public confidence in data systems.

- Offer training programmes to build a skilled workforce in data management and analytics to improve the quality of AI data-driven decision-making.

3.6 AI skills, human capacity and resources

Most public officers in Uganda possess basic digital literacy, enabling them to use digital tools and perform essential computing tasks required for e-government services. However, there is a noticeable gap when it comes to more advanced data skills, such as data collection, processing, and analysis. While some specialized government agencies, such as the Ministry of ICT and National Guidance and NITA-U, have personnel with moderate data skills, many others still lack exposure to data-driven processes. This gap hampers their ability to work with AI-driven applications or make decisions based on data. This skill is increasingly essential for AI integration.

Currently most organizations in Uganda do not have dedicated establishments for AI-related skills (60%) due to a combination of factors, including cost, expertise, strategy, and organizational readiness. There is, however, development in progress (10%) to constitute the establishment of AI related skills. The integration of AI skills in workplaces would become important because they empower organizations to improve efficiency, innovate, improve decision-making and address challenges in a rapidly evolving technological landscape. This is expected to enable

institutions to improve service delivery to the citizens. The survey identified the following AI skills (Figure 15) which are demanded within the organization.

Figure 15: Demand for AI skills
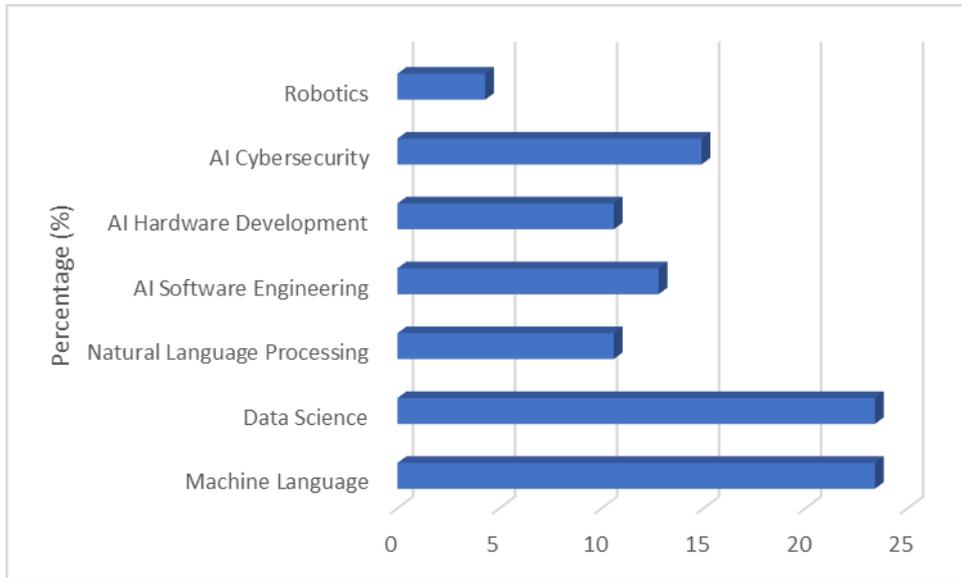
Source: Project research, 2024.

Data science, machine learning (ML), and AI cybersecurity have gained prominence because they address critical challenges and opportunities in a data-driven, technology-centric world. Data science focuses on extracting actionable insights from vast amounts of data and has become indispensable due to the exponential growth in data generation. Machine learning allows machines to learn and improve predictions based on experience. The potential of ML allows institutions to improve decision-making, develop new products and enhance customer experience. Natural language processing (NLP) is a technology that gives computers the ability to interpret, manipulate, and comprehend human language. This technology is important for use by organizations to automatically process large volumes of voice and text data. The data may be from various communication channels such as emails, text messages, social media newsfeeds, video and audio. NLP technology then is used to tease out the intent or sentiment in those messages to respond in real time to human communication such as is being experienced with the use of generative AI.

Despite the many advantages of AI technology, many public officers have limited understanding of AI concepts, including its capabilities, ethical challenges, and potential benefits for public service. Basic terms such as AI, ML, predictive analytics, and automation are still unfamiliar to most. This lack of awareness often creates hesitation in the adoption of AI technologies. If AI is seen as an abstract or intimidating concept, officers may resist its implementation. To address this, introducing basic training and awareness campaigns can help demystify AI, making it more accessible and encouraging its adoption in the public sector.

In terms of the capacity of Uganda's educational institutions producing AI ready graduates, 63.6 per cent of the respondents believe that it is not adequate while 27.3 per cent of the respondents stated that its adequate with 9.1 per cent who do not know whether its adequate or not. With the low level exhibited, capacity building in AI within higher education institutions would be critical for fostering innovation, ensuring societal relevance, and preparing students, educators, and researchers to thrive in the rapidly evolving technological landscape.

Capacity building in AI within higher education institutions is critical for fostering innovation, ensuring societal relevance, and preparing students, educators, and researchers to thrive in a rapidly evolving technological landscape. Capacity build would promote cutting edge research in AI since it is a transformative field that drives innovation in industries such as healthcare, finance, agriculture, and education. It would also prepare students for future careers and foster interdisciplinary collaborations.

The challenges organizations face in attracting and retaining AI talents are as shown in Figure 16.

Figure 16: Challenges in attracting and retaining AI talent
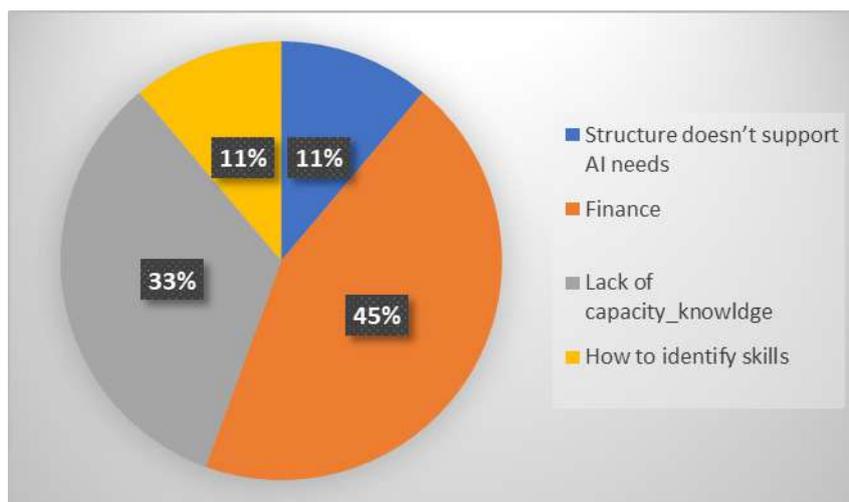
Source: Project research, 2024.

Finance to pay renumeration of AI talents is a major challenge in retaining the resource. AI talent is the core of developing and operationalizing AI models in organizations and require specialized skills which are rare and expensive, hence finance may be a challenge. Lack of capacity and skills of how to apply AI in organization limits them from conducting state-of-the-art research, contributing to the body of knowledge and addressing local challenges. Artificial Intelligence technology is a rapidly evolving field that requires substantial investment in research and development for institutions to tap the benefits such as enhanced productivity and operational efficiency. An interesting response was that the current structure in organizations doesn't support AI needs oblivious of the fact that it is a cutting-edge technology.

Nearly 64 per cent of institutions are not currently involved in any AI training or capacity building initiatives while 9 per cent are in development. This demonstrates lack of AI readiness in terms of capacity to integrate the technology. Efforts, however, are being made by some institutions to appreciate AI as indicated with 27 per cent involved in AI training and capacity building. The significant barriers to developing AI talents are as shown in Table 3.

Table 3: Significant barriers to developing AI talent

Barrier	Response (%)
Lack of AI specific education programmes	26.7
Lack of practical hands-on AI training	33.3
Limited research and development opportunities	23.3

Table 3: Significant barriers to developing AI talent (continued)

Barrier	Response (%)
Limited awareness of AI career opportunities	16.7

The barriers in Table 3 support why most institutions are not currently involved in AI initiatives and these concerns need to be addressed to encourage readiness to adopt AI ecosystem in institutions. Practical hands-on AI training (33.3%) is paramount in ensuring that the transformative potential of AI can be fully realized across sectors. However, in this study many of the organizations lack this skill. The curriculum in the Uganda education system is not explicit about AI courses and programmes (26.7%). These courses are necessary to equip future generations to enable them to navigate and shape an AI-driven world responsibly, ethically, and innovatively. Limited AI research and development opportunities (23.3%) hinder Uganda's capacity to leverage AI for socio-economic growth, foster innovation, and tackle critical local challenges using AI tools effectively while limited awareness of AI career opportunities (16.7%) was rated least as a barrier to developing AI talents. Limited awareness of AI career opportunities hinders the development of a skilled talent pool, slows technological advancements, and impedes socio-economic progress. To overcome this challenge, governments, educational institutions, and industry leaders should implement targeted awareness campaigns, incorporate AI into educational programmes, and nurture the socio-economic advantages of AI to foster a more inclusive and competitive workforce.

The major specific policies or regulatory actions which respondents advise that the government of Uganda should priorities are creating an AI enabling environment (14.3%), development of an AI strategy (14.3%), development of AI legal and regulatory framework (14.3%); and AI policy formulation (28.5%). Policies play a critical role in fostering an AI-enabling environment by creating a structured, supportive, and ethically responsible ecosystem for the development, adoption, and integration of AI technologies. Develop policies that are customized to Uganda's AI ecosystem. The framework and strategy demanded by the respondents are essential to guide the development and deployment of AI by ensuring that AI technologies are developed responsibly, used ethically, and aligned with societal values.

Partnership and collaborations that could accelerate AI development in Uganda include collaboration with parallel institutions (25%), collaboration with academic institution (25%), development of AI innovation hubs (12.5%), public private partnerships (12.4%), skilling and attachment for internship (25%). Partnerships and collaborations create synergistic environments that amplify the potential of AI development. By combining resources, expertise, and networks across sectors they accelerate innovation, and ensure AI technologies are developed responsibly and equitably.

Table 4 reflects how respondents expected Ai to transform the Uganda economy.

Table 4: Expected role of AI in transforming the Uganda economy

Role of AI transforming economy	Response (%)
Enhance service delivery	42.8
Enhance development	19.0
Improve agricultural production	14.3

Table 4: Expected role of AI in transforming the Uganda economy (continued)

Role of AI transforming economy	Response (%)
Unlock new potential	4.8
Enhance financial stability	14.3
More dysfunctional services	4.8

Majority of the respondents indicated enhancement of service delivery (42.8%) as the most significant role of AI in transforming Uganda's economy. However, other prominent responses include enhanced development (19%), improved agricultural production (14.3%), and strengthened financial stability (14.3%).

A minor interesting response is that this technology may unlock new potential (4.8%) and cause disruption and more dysfunctional service (4.8%). AI has the potential to unlock new opportunities by revolutionizing how organizations operate, enhancing decision-making, and driving innovation. However, AI can disrupt existing systems by transforming traditional workflows, altering business models, and challenging established norms. While such disruption can drive innovation and efficiency, it may also create challenges if not managed effectively.

The top sectors where AI can provide the most significant benefits in Uganda were recorded as in Table 5 as: health (25.8%), education (19.4%), financial (16.1%), agriculture (16.1%), transport (9.7%), energy (6.5%), telecommunication (3.2%), and security (3,2%).

Table 5: Sector where AI can provide the most significant benefits

Role of AI	Response (%)
Health	25.8
Financial	16.1
Education	19.4
Agriculture	16.1
Transport	9.7
Energy	6.5
Telecommunication	3.2
Security	3.2

The health sector is experiencing a new revolution with AI supporting improvement in efficiency of the delivery of health care services, the speed and accuracy of diagnoses, treatments, and patient care. A healthy nation will lead to increased labour supply and productivity driving in growth domestic product (GDP) therefore improved livelihood of citizens.

In the finance sector AI supports areas such as economic analysis and policy formulation more especially in macro-economic forecasting. Government can use AI models for economic forecasting, allowing for better fiscal policy decisions. The future in education is in personalized learning where AI enables tailored educational experiences to meet individual student needs. AI provides educators with tools to enhance teaching effectiveness, accessibility, inclusiveness and

administrative efficiency. AI has the potential to significantly impact and enhance the agriculture value chain at various stages, from farming and production to distribution and consumption. Its application in agriculture extends to optimizing agricultural practices, improving crop yield, and reducing waste by integrating data-driven insights and innovative tools. This empowers farmers to make more accurate and efficient decisions about planting, watering, fertilizing, and harvesting.

AI is revolutionizing the transport sector by introducing smarter, more efficient, and safer systems. Examples may include the use of AI algorithms in prediction of mechanical failures in vehicles or infrastructure, minimizing risks and accidents. Traffic management, which can be a game changer in the urban traffic management for example in Kampala City where it can analyse traffic patterns and adjusts traffic lights or suggests alternative routes to reduce congestion, enhance efficiency and make data driven decisions. In the Energy sector it may be used to optimize energy production and distribution such as for electricity where it can help in the balance of supply and demand by optimizing the flow of energy through power grids and ensuring efficient distribution example for Uganda sources such as Own Falls dam, Bujagali dam and the soon to be completed Karuma dam. In the telecommunication sector it is used to enhance network performance, improve customer experience, and streamline operations while in the security sector it may be used to identify potential cyber threats, such as malware, ransomware, or phishing attacks.

The support that would be most helpful in developing AI solutions in Uganda include technical (39.1%), financial (30.4%), coordination (17.4%) and policy (13%). Developing an AI solution requires technical expertise, strategic planning, and access to the right tools and technologies to build a scalable, efficient, and impactful AI solution. Financial support is necessary in the development of AI solutions due to the significant costs associated with various stages of their lifecycle. These costs arise from the need for specialized talent, advanced infrastructure, tools, and ongoing maintenance.

At least 91.7 per cent of the respondents intend to implement AI in their organizations soon. Out of the organizations that have deployed or wish to deploy AI, 18 per cent of them intend to implement chatbots and another 18 per cent intend to implement AI to support forecasting in their organizations. Other AI services respondents plan to implement includes AI for diagnosis (9.1%), AI for optimization (9.1%), AI for land management (9.1%), AI for predictions (9.1%), AI for image and text analysis (9.1%), and AI for risk identification (9.1%).

Technical skills for AI development and deployment

Developing AI technologies requires specialized technical skills, including proficiency in frameworks which are a collection of tools and resources; and programming languages such as Python and R, as well as computational models such as ML algorithms and data science tools. Currently, Uganda's public sector has a small pool of officers with these skills, primarily in select agencies such as health and agriculture. While a few technically skilled personnel can conduct basic data analysis, there is a significant shortage of staff who can develop or adapt AI models for practical use. To establish leadership in AI application, Uganda must invest in training its workforce to build these advanced technical competencies.

Competence in AI deployment and operational use

Beyond developing AI models, implementing and managing AI systems in public service applications requires skills in system integration, data security, and user training. Most public

officers currently lack the ability to manage AI projects independently. Consequently, many AI initiatives are outsourced to private companies or implemented in partnership with international organizations. To ensure sustainability and scalability, it's vital to build in-house expertise for managing, deploying, and maintaining AI systems within the public sector.

3.7 Entities impacted by AI

Section 3.1 discusses some of the risk concerns in AI development and deployment in Uganda by the MDAs and the private sector. The impact of these risks identified on the respondent's services, employees, customers and public were assessed to ensure responsible, fair, and beneficial deployment of AI systems. The major impact is on the public (40%) followed by employees (33.3%) then customers (26.7%) as in Figure 17.

Figure 17: Entities/people impacted by AI
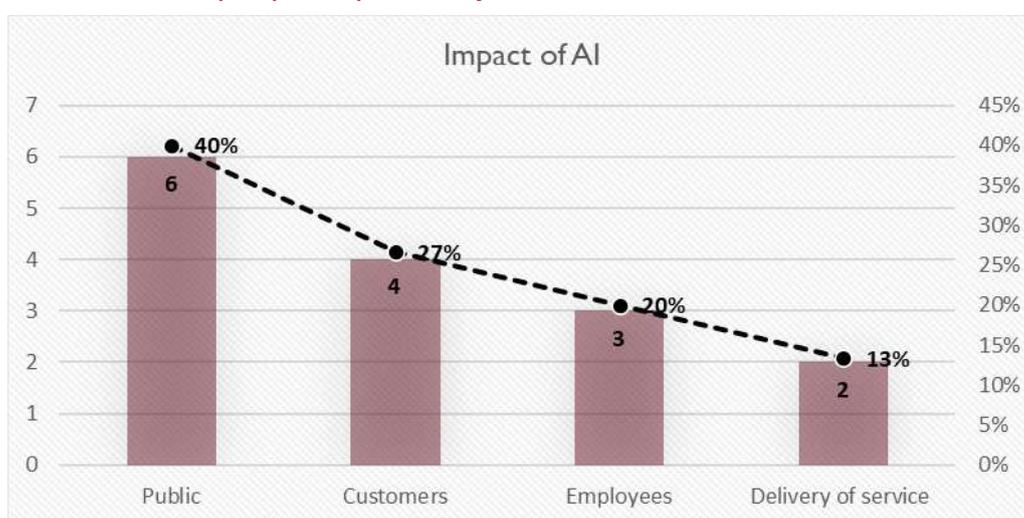
Source: Project research, 2024.

It can be argued that customers can form part of the public making it crucial to take care of its impact both positive and negative. The multifaceted impact of AI therefore is both promising and concerning. While AI is enabling innovative business models, increasing economic opportunities, and augmenting human capabilities it is also causing disruption in other areas such as employment, raising ethical dilemmas around bias and discrimination, and blurring the lines between human and machine. Only by taking a balanced, proactive and multidisciplinary approach can we fully harness AI potential while safeguarding against its perils on this transformative technological frontier.

On the severity of AI impacts in organizations on a scale of 1(low) to 3 (high), 60 per cent intimated that the impact is low while 18 per cent is high and moderate 22 per cent as shown in Figure 18.

Figure 18: AI impact rating
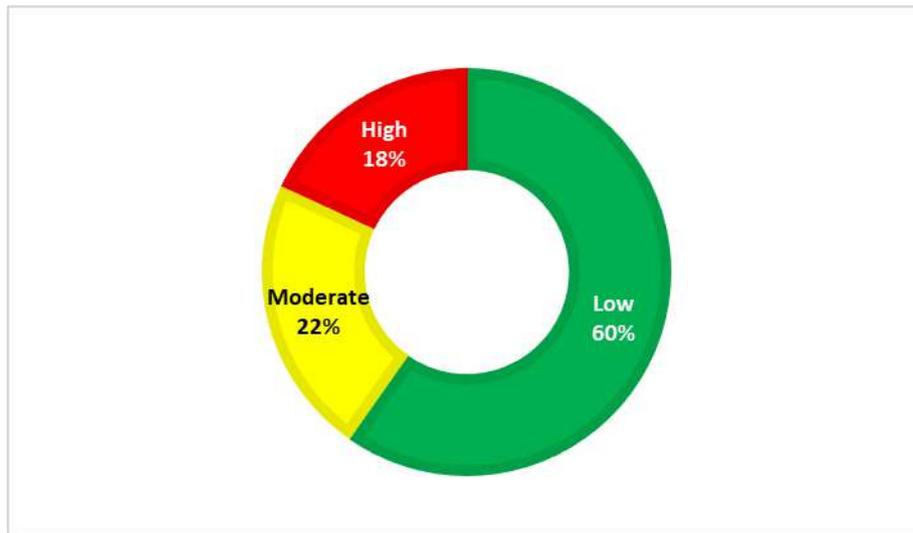
Source: Project research, 2024.

Since the AI ecosystem is not yet well established in Uganda there could be an assumption that its impact is low however, lack of knowledge of AI risks can lead to risks.

Most of the organization mitigate (55%) the AI risks while 27 per cent avoid with 9 per cent accepting and transferring the risks respectively. No organization had adopted any AI risk managements framework, standards, auditing or incident response plans. However, the use of AI risk management frameworks, AI auditing standards and AI incidents response plan to mitigate the negative impact of AI and harness the benefits of AI technologies are important in an AI ecosystem. This study will go along to propose an AI risk management framework which will be a step forward in guiding the public and private sector towards a responsive and ethical development of AI technology in Uganda.

4   Stakeholder consultation

The stakeholders consulted are detailed in section 1.4. The consultation was to gain insight into challenges faced by key public and private actors in the AI ecosystem and recommendations as in section 7. The interview, baseline survey and webinar provided valuable insights into Uganda's AI landscape, highlighting both opportunities and pressing challenges. While there is growing interest in AI as a transformative technology with the potential to drive economic growth and innovation, several barriers continue to hinder its development and adoption across the country.

4.1   Lack of AI awareness and understanding

The stakeholders highlighted lack of awareness and understanding of AI among stakeholders. Many organizations, particularly within the public sector, have limited knowledge about the capabilities and potential applications of AI technologies. This lack of understanding results in hesitation to adopt AI as well as limiting the ability of key stakeholders to appreciate the transformative potential of AI in areas such as healthcare, agriculture, and financial services. Stakeholders often express scepticism, favouring traditional methods due to concerns about accuracy and cost of the technology in addition to privacy concerns.

The private sector, while quicker to acknowledge the transformative potential of AI, is wary of the high costs associated with its integration. This reluctance is further compounded by a perception that AI technologies are primarily suited to large, tech-savvy corporations, leaving smaller businesses feeling alienated from the opportunities AI presents.

4.2   Lack of skilled workforce and capacity building programmes

Participants reiterated that investment in AI technology and skills is not looked at as a long-term journey for multi-generations. There is a shortage of skilled professionals capable of developing, deploying, and managing AI solutions. The shortage of a skilled workforce remains one of the most pressing bottlenecks in Uganda's AI ecosystem. Developing and deploying AI systems require expertise in diverse fields such as data science, machine learning, neural networks, software engineering, and domain-specific knowledge. However, Uganda faces significant challenges in cultivating this talent pool. Existing resources and trainers with expertise in AI are scarce, which limits opportunities for skill development.

While open-source AI tools are available, they often demand advanced technical proficiency, which many professionals lack. Additionally, the limited presence of specialized skilling programmes in academic institutions exacerbates this issue. Though several ICT courses are offered at universities and the Ministry of ICT and National Guidance, few are tailored specifically to AI, machine learning, or data science. Where the courses are offered there is need for sensitization of the public into how they can take advantage of the programmes. Participants also strongly think certification of local experts in AI subjects should be encouraged. This could be achieved through programmes at Ministry of ICT and National Guidance. There is limited funding in place to support AI Initiative.

4.3   Data availability, accessibility, and quality issues

The participants argued that the challenge with implementing AI is lack of quality data which is needed for training of AI models. The lifeblood of AI is quality data and without its users can end up making biased decisions. The effect of making biased decisions has far-reaching effects and can exacerbate existing inequalities, compromise system integrity, diminish trust of users, and ethical considerations.

There are manual data capture and processes in some MDAs which compromise the quality of data being used to support decision-making and efficiency in delivery of services. In some instances, there are no standard data or information sources as in the case of administrative divisions as districts, counties, sub counties, parishes and villages. Capturing them as free text at ingestion leads to possible errors and inconsistency.

AI systems depend on high-quality, reliable data, but stakeholders highlighted problems with data availability, accessibility, and governance. Much of the data required for AI projects is fragmented, stored in silos across various institutions, or not digitized at all. Additionally, concerns about data privacy and security discourage data sharing, even when clear legal frameworks such as the Uganda Data Protection and Privacy Act, 2019 are in place. Without comprehensive, accessible, and standardized datasets, AI applications struggle to achieve accuracy and scalability.

Data maturity, which is a measure of how well an organization uses data to support its business goals and make decisions, is lacking as most organizations have not incorporated data-decision making into every aspect of their operation. Without a sufficient level of data maturity, AI tools may struggle to interpret the data accurately, leading to suboptimal outcomes or erroneous conclusions, thus undermining the potential benefits of automation and advanced analytics in decision-making processes.

Lack of a centralized data repository which could serve as a unified data management platform that consolidates siloed data from across MDAs into a single, integrated source. This would make it easy to have a uniform identifier which could be fields such as a national identification number (NIN) or tax identification number (TIN) used across all organizations to support service delivery to citizenry.

There are instances where different data and statistics on the same subject are shared at different forums, and this may bring in delays in delivery of services due to misinformation. Participants suggested that integration of AI in all new interventions may minimize such occurrences. The lack of a unified data-sharing framework exacerbates this issue, making it challenging to gather comprehensive datasets for AI projects.

There are also significant concerns about data privacy, particularly when handling sensitive personal information. While Uganda enacted the Data Protection and Privacy Act in 2019, its enforcement remains weak. Without clear guidelines on data usage for AI, stakeholders are hesitant to share data, stifling collaboration and innovation in the AI space.

4.4   Limited computational resources and infrastructure

The infrastructure required to support AI development and deployment is also insufficient. Many organizations lack the computational resources, such as high-performance computing systems, needed to handle the demands of AI workloads. Limited access to reliable, high-speed

Internet further compounds the problem, particularly for organizations relying on cloud-based AI services. Without these critical enablers, stakeholders find it challenging to experiment with, implement, or scale AI initiatives effectively.

There is a lack of appropriate AI infrastructure with high computing power for development and deployment of AI solutions. However, few private sector organizations have acquired and set up some scalable infrastructure for AI initiatives. Participants advised the government and intended AI deployers to invest in hyperscale technology. This is a computing architecture that can be scaled to meet increased demand since AI is a growing technology. It's used in cloud computing and big data, and is designed for high performance, throughput, and redundancy. Government can use similar approaches to figure individual citizen needs dependent on data and skills. This could support equitable service delivery, supported by initiatives such as the ongoing PDM.

The computational infrastructure required to develop and deploy AI applications is a significant barrier. AI and machine learning systems demand high-performance computing (HPC) capabilities and reliable connectivity, which many organizations in Uganda lack. Resource-constrained environments make it difficult for businesses to acquire the necessary computational tools to process large datasets or train complex models.

There is limited access to reliable, high-speed Internet which hinders access to cloud-based AI tools and real-time data processing. Poor and inconsistent connectivity often disrupts AI workflows, making it difficult to experiment with or scale AI projects effectively.

There is a plan to institutionalize IT infrastructure in MDAs so that it is adopted by MDAs. Deploying AI technologies in MDAs can reduce the burden on human resources, minimize errors, and expedite the completion of repetitive tasks. The Ministry of ICT and National Guidance is expected to fund and put in place a government cloud in the next financial year.

4.5   Inadequate research and development investment

Innovation in AI thrives on research and development, yet Uganda's investment in this area remains inadequate. Limited public funding for AI research and private sector investment, constrained by fears of high risks and uncertain returns, poses significant barriers. This lack of financial support limits access to resources such as data, computational tools, and collaborative opportunities, stifling the development of AI solutions tailored to Uganda's unique challenges.

Local investors and suppliers are not given the opportunity to supply AI equipment, technology and solutions yet they would use such opportunity to develop appropriate local solutions that are fit for purpose for Uganda.

AI has the potential to significantly enhance citizen engagement by introducing innovative solutions that foster more personalized and responsive interactions between governments and citizens. Like AI-powered chatbots, they can provide instant and accurate information to citizens, addressing common queries and guiding citizens through various government services. This not only improves the efficiency of service delivery but also ensures that citizens have easy access to the information they need.

Collaboration between universities, private technology firms, and government bodies is minimal, restricting knowledge exchange and the development of AI solutions tailored to local challenges. While some universities are conducting promising research in AI, there are few

mechanisms to translate these academic insights into practical applications that address local challenges. Efforts to support innovation, such as incubation centres established by the Ministry of ICT and National Guidance, remain underfunded and unable to scale their impact effectively.

Many businesses prioritize short-term profitability over long-term investments in R&D, further stifling innovation. This focus on immediate gains over strategic advancements has hindered the emergence of locally developed AI technologies that could provide Uganda with a competitive edge.

A concern raised was that at a strategic level how can this technology be leveraged to develop the country? What are the critical national problems now? Potential users of AI are raising their voices on why government does not give tax exemption and incentives on equipment, accessories and infrastructure deployed in the AI ecosystem. AI technology is not solving national problems such as youth unemployment, health promotions and education.

4.6   Policy, regulatory and governance gaps

There is a lack of a comprehensive AI policy, legal and regulatory framework to guide the development, deployment, and ethical use of AI technologies. This absence creates uncertainty for organizations, particularly regarding compliance and risk management. For instance, in critical applications such as healthcare, there is often no clarity about accountability when AI systems make errors or decisions. This lack of regulation also increases the risk of biased AI systems perpetuating discrimination in areas such as hiring or credit scoring. There is also a lack of standards to support AI development and deployment. However, as specified by the Ministry of ICT and National Guidance the policies are under review.

Although Uganda has enacted the Data Protection and Privacy Act, 2019, organizations face challenges interpreting its provisions, especially concerning the use of personal data for AI applications. The lack of robust governance structures weak enforcement of existing laws, such as the Data Protection and Privacy Act, exacerbates these issues, leaving organizations hesitant to explore AI-driven innovations.

Lack of a proper governance structure to support AI initiative leading to different entities deploy different standards. Can we have a unified standard adopted and customized by the different entities was the request of the participants. The call for action from participants was that the Ministry of ICT and National Guidance should help to put in a structure which trickles the technology application from top policy management down to the expected users.

It was however reported in the meeting that the Ministry of ICT and National Guidance is drafting a guideline to advise government on which AI infrastructure, equipment and accessories that could be imported free of tax to encourage adoption of AI in Uganda

4.7   High costs of AI solutions

The financial burden of adopting AI technologies poses a significant challenge. Many organizations lack the resources for the initial investment required to implement AI systems, including software acquisition, infrastructure upgrades, and staff training. Beyond these upfront costs, maintaining AI solutions involves recurring expenses such as data acquisition, model retraining, and system updates. These costs are often prohibitive for organizations with limited budgets, discouraging them from exploring AI opportunities.

4.8   Cultural inertia

Resistance to change, or cultural inertia, remains a significant barrier to AI adoption in many workplaces. Employees and organizations are often reluctant to embrace new technologies, preferring to stick to traditional methods. This mindset slows down the digital transformation process and limits the potential benefits AI could bring to Uganda's public and private sectors.

5 Benchmarking study

Benchmarking with other countries provided information on how they successfully created an enabling environment providing supportive infrastructure for AI deployment and use. The selection of countries for benchmarks was based on key pillars related to a country's AI ecosystem from the government AI Readiness Index 2023 framework used for assessment of the readiness of a country to adopt, implement, and benefit from AI. The pillars being government, technology sector, data and infrastructure. The important dimensions as identified in the UNESCO Readiness Assessment Methodology (RAM) which encompasses five dimensions as legal and regulatory, social and cultural, economic, scientific and educational, and technological and infrastructure were incorporated. Other attributes were borrowed from the UNDP AI Readiness Assessment (AIRA) tool which examines three core pillars: government as a user of AI in public service delivery and operations; government as an enabler of a wider AI ecosystem, and the country-wide development of ethical AI principles and practices; in addition to the interactive TDWI AI Readiness Assessment tool, which looks at five categories that form the dimensions of the TDWI AI Readiness Model: organizational readiness, data readiness, skills readiness, operational readiness and governance readiness.

The insights gained informed Uganda's efforts to establish an enabling environment for digital transformation, ultimately driving sustainable socio-economic development across the country. The countries chosen for the benchmarking exercise were Kenya, Rwanda, and the United States. Rwanda and Kenya share economic similarities with Uganda and have made significant progress in creating an enabling environment with supportive infrastructure for AI deployment and use. In contrast, the United States has established advanced AI regulatory frameworks, infrastructure, and a highly skilled workforce, offering valuable insights and best practices that can be adapted and implemented. Recommendations from the benchmark study are presented in section 7.

5.1 Selection of countries for the study

Based on the 2023 index rankings, UNESCO Readiness Assessment Methodology (RAM) and UNDP AI Readiness Assessment (AIRA), three countries, Kenya, Rwanda, and the United States were selected for the study. The choices offer insights into both regional peers and a global leader in AI readiness providing a robust comparison for Uganda's AI capabilities.

Within the sub-Sahara Africa, Rwanda and Kenya ranks 3rd and 6th, respectively, while Uganda ranks 12th in the index. Kenya and Rwanda have both made significant strides in establishing policies, infrastructure, and innovation in the ecosystems that foster AI development. Their progress offers relevant case studies and learning opportunities, given their contextual similarities with Uganda, including:

a) Economic structure: Rwanda, Kenya, and Uganda all mainly depend on agriculture-based economies. They support substantial export markets in agricultural products and mineral resources.

b) Regional integration and trade: As members of the East African Community (EAC), these countries benefit from economic integration policies that encourage cross-border trade, digital innovation, and investment in shared infrastructure, such as the Port of Mombasa, a vital link for trade and transportation.

c) Service sector contributions: All three economies of Uganda, Kenya and Rwanda derive significant revenue from tourism, benefiting from a rich ecosystem of natural resources and cultural heritage. Tourism presents further opportunities for AI-driven solutions, such as data analytics for personalized visitor experiences and resource management.

d) Demographic factors: A common characteristic across these nations is a young, growing population facing similar socio-economic challenges, particularly in the areas of unemployment and poverty. These demographic dynamics underscores the potential for AI to create employment opportunities and address developmental needs.

The United States, consistently ranked at the top of AI readiness indices, providing a benchmark of advanced AI implementation, policy development, and technological infrastructure. Leadership spans all three pillars of readiness, with strong institutional support for AI research, a mature technical ecosystem, and well-established data infrastructure. The United States is also known for AI initiatives that have shaped both national and global AI policies and standards.

Benchmarking Uganda against the United States provided a contrast in scale, policy ambition, and technological foundation, offering insights into best practices and the scalability of AI solutions. The experience of the United States in navigating regulatory frameworks, fostering public-private partnerships, and investing in foundational infrastructure serves as a model for Uganda's own pathway to AI readiness.

Through this benchmarking exercise, comparing Uganda with Rwanda, Kenya, and the United States provided a balanced perspective on strengths, gaps, and opportunities for improvement in Uganda's AI ecosystem. This comparative analysis will guide recommendations that are not only contextually relevant but also adaptable to Uganda's unique socio-economic environment.

A comparative analysis of AI preparedness across selected countries is summarized in Table 6.

Table 6: Comparative analysis of AI preparedness in the benchmarked countries

Area of AI support	Uganda	Kenya	Rwanda	United States
Digital Infrastructure and connectivity	– Infrastructure under development, with ongoing efforts to scale it up. – Network Coverage: Reasonable in urban areas, limited in remote regions. – Data Centre: National Data Centre exists but with limited capacity for high-performance computing (HPC).	– Infrastructure under development and to be scaled up – Network coverage is reasonable – Available Data Centre but with limited capacity	– Made stride in Infrastructure development however there is still needed to scale up. – Network coverage is reasonable – Available Data Centre but with limited capacity for large-scale AI workloads.	– Robust AI infrastructure that supports seamless development, deployment, and operation of AI technologies – Network coverage: High-speed Internet and 5G widely available. – Data Centre: Extensive use of cloud platforms (AWS, Google Cloud, Microsoft Azure) with immense storage and computational power necessary for large-scale AI development and deployment

Table 6: Comparative analysis of AI preparedness in the benchmarked countries (continued)

Area of AI support	Uganda	Kenya	Rwanda	United States
Human Capital and Education	– Skills Gap: Low digital and technical skills among the workforce; limited AI expertise. – Education: Emerging interest in data science and AI but lacks widespread curriculum integration in higher education. – Training: Need for upskilling programmes, especially in public sector roles.	– Skills Gap: Similar to Uganda, with limited technical expertise in AI. – Education: Increasing incorporation of data science courses in universities; government encouraging digital literacy initiatives. – Training: Emphasis on coding bootcamps and innovation hubs to bridge skills gaps.	– Skills Gap: Similar challenges with digital literacy but a growing focus on tech education. – Education: Launching initiatives to include AI and data science in school curricula. – Training: Targeted programmes in coding and digital skills, especially for young people.	– High Proficiency: The United States has a highly skilled workforce in technology, AI, data science, and related fields. – Education: Advanced university programmes in AI, data science, and ML across top institutions. – Training: Continuous professional development and a culture of lifelong learning in technology.
Government policies and support	– No AI Policy Framework: No comprehensive AI strategy in place yet; ICT policies focus on general digital transformation. – Developments: Efforts underway to draft an AI policy with support from international partners.	– Emerging AI Strategy: Recently launched a national AI strategy with goals to integrate AI in public services and boost the digital economy. – Support: Active government backing for digital transformation projects.	– Active AI Strategy: National AI policy framework focusing on capacity building, innovation, and ethical AI use. – Support: Government-driven initiatives to boost digital skills and support technical startups.	– Comprehensive Policies: Strong, established AI strategy and numerous policies promoting research, ethical use, and innovation. – Support: Federal and state-level programmes to fund AI research and development, including regulatory sandboxes for testing new AI technologies.

Table 6: Comparative analysis of AI preparedness in the benchmarked countries (continued)

Area of AI support	Uganda	Kenya	Rwanda	United States
Research and innovations in AI ecosystem	– Low Activity: Limited research output and few AI-focused projects; nascent innovation ecosystem. – Hubs: Emerging innovation hubs but need greater support and investment to scale AI initiatives.	– Gradual increase in AI research and innovation, supported by innovation hubs and incubators such as Nairobi's iHub. – Hubs: Strong technology scene but still building AI-specific capabilities.	– Rwanda's Kigali Innovation City is a focal point for AI research and entrepreneurship. – Hubs: innovation hubs focused on promoting digital solutions, with growing interest in AI applications.	– Mature Ecosystem: High levels of research, innovation, and commercialization of AI technologies. – Hubs: Numerous established research labs (e.g., MIT, Stanford, Google AI Labs), incubators, and tech giants driving cutting-edge AI innovation.

Table 6: Comparative analysis of AI preparedness in the benchmarked countries (continued)

Area of AI support	Uganda	Kenya	Rwanda	United States
Data governance	– Data protection and privacy law enacted but need strengthening and enforcement to support AI data needs.	– Data protection law enacted with ongoing improvements to address new digital challenges.	– Data protection and privacy law enacted	– Strong data governance frameworks such as data ethics framework whose purpose is to guide federal leaders and data users as they make ethical decisions when acquiring, managing, and using data to support their agency's mission. – Comprehensive data governance policies aligned with standards such as GDPR which is a law on data protection and privacy of European Union citizens. – Strengths: Clear guidelines on data privacy, protection, and ethical use of AI-driven data insights.

Table 6: Comparative analysis of AI preparedness in the benchmarked countries (continued)

Area of AI support	Uganda	Kenya	Rwanda	United States
Ethical governance	– No Specific AI Policy addressing AI ethics, fairness, and accountability. – Discussions are ongoing to integrate ethical guidelines into the forthcoming AI strategy.	– No Specific AI Policy: Similar to Uganda, but initial steps are being taken to draft guidelines for ethical AI use.	– No Specific AI Policy. Efforts are underway to develop guidelines focused on AI fairness and bias prevention, linked to broader digital ethics initiatives.	– Comprehensive Framework with multiple executive orders and guidelines focused on AI transparency, fairness, and accountability. – Focus: Ethical principles aim to prevent bias, promote explainability, and ensure equitable AI outcomes.

5.2 Strides in creating an enabling environment for AI

The three benchmarked countries have made strategic investments to foster a supportive ecosystem for AI by focusing on key elements such as digital infrastructure, regulatory policies and frameworks, human capital, innovation ecosystems, and sectoral AI adoption. This comprehensive approach aims to create an enabling environment for AI deployment, driving national development and economic growth.

1) Digital infrastructure - High-speed, reliable Internet connectivity is foundational for AI applications, especially those leveraging cloud services and real-time processing. Each country has implemented initiatives to improve Internet connectivity, with a strong emphasis on expanding broadband to rural and underserved areas. This is crucial for equitable AI access and participation. Notably, Uganda has centralized its data capabilities through the National Information Technology Authority (NITA-U) data centre, while Kenya is emerging as a regional hub for cloud services, hosting data centres such as those of Liquid Telecom. Rwanda has developed the Rwanda East African Data Centre, underscoring its commitment to providing the substantial computational power required for high-performing AI models and large-scale data storage.

2) Government policies and regulatory frameworks - A structured regulatory framework is essential for safe and ethical AI development and deployment. Rwanda leads the way with a national AI strategy in place, while Uganda is currently formulating policies to integrate AI into its broader ICT agenda. All three countries have enacted comprehensive data protection and privacy laws: Uganda's Data Protection and Privacy Act (2019), Kenya's Data Protection Act (2019), and Rwanda's Data Protection Law (2019). These laws safeguard individuals' rights to privacy, ensuring that personal data is collected and processed responsibly, in alignment with international standards. Furthermore, efforts are underway to establish AI ethics frameworks in each country. These frameworks will address critical concerns, such as bias, transparency, and accountability, thereby fostering responsible AI use across various sectors.

3) Human capital and skills development - Building a skilled AI workforce is a priority for all three countries. Universities, such as Makerere University in Uganda and Strathmore University in Kenya, have incorporated AI-related courses to train the next generation of AI

practitioners and advocates. Additionally, governments are collaborating with the private sector and international organizations such as UNESCO to offer targeted AI training programmes, which aim to develop AI expertise and digital literacy at various levels. This multi-sectoral approach to skill-building is vital for creating a local talent pool capable of advancing AI research, development, and practical application.

4) Innovation and research ecosystems - A robust innovation ecosystem catalyses AI adoption by providing resources and support for research, startups, and technical collaboration. Each country has made significant strides in establishing AI research centres and innovation hubs. For example, Kenya's iHub serves as a collaborative space where AI startups can connect, innovate, and thrive. Strategic partnerships with major technology companies such as Google, IBM, and Microsoft are common across all three countries, with universities and startups benefiting from these collaborations. These partnerships often involve access to AI labs, mentorship programmes, and funding opportunities, strengthening the research and development pipeline for AI technologies.

5) AI adoption in key sectors - Government-led AI adoption in priority sectors demonstrates the commitment to enhancing service delivery through innovative solutions. Rwanda's collaboration with Zipline for drone-based drug delivery is a notable example of leveraging AI and related technologies to solve critical challenges in healthcare. Similarly, precision agriculture, which integrates advanced technologies and data analytics to optimize farming, is a growing focus in all three countries. This approach aims to improve agricultural productivity while minimizing environmental impact, which is a vital aspect for these largely agrarian economies. Each government is also exploring further AI applications in health, education, and infrastructure to drive public sector efficiencies and improve citizen services.

6) Open data initiatives and public datasets - Recognizing the importance of accessible data for AI training, all three countries are taking steps to make government datasets more publicly available. Kenya's Open Data Initiative offers accessible datasets on health, education, and infrastructure, providing valuable resources for AI research and application. Uganda and Rwanda are currently in discussions regarding public access to key datasets, with government ministries exploring how to make datasets available for AI development and research. This open data approach is foundational for fostering local AI innovations and enabling data-driven solutions across sectors.

These benchmarking insights reveal a shared commitment among the countries to build an AI-ready environment. Their concerted focus on digital infrastructure, robust policies, skilled workforce, innovation ecosystems, and public data access is driving transformative progress in AI readiness. Uganda can draw upon these experiences to strengthen its national AI strategy, ensuring that the foundation is laid for sustainable AI adoption and usage in alignment with national development goals.

5.3 Existing initiatives, policies, laws, and regulations supporting AI development and deployment

Countries across the globe are recognizing the transformative potential of AI and are actively developing policies, laws, and regulatory frameworks to support and govern its development, deployment, and use. These initiatives are intended not only to enable innovation but also to mitigate risks associated with AI, such as ethical concerns, privacy issues, and the economic impact of automation.

The pace and scope of these AI governance frameworks vary significantly across countries, reflecting differences in technological maturity, regulatory priorities, and economic conditions. This benchmarking study focuses on Kenya, Rwanda, and Uganda which are countries in East Africa that are beginning to establish regulatory and policy foundations for AI as well as the

United States, a global leader in AI governance, which offers valuable insights and best practices for emerging economies.

5.4 Benchmarking study of the United States on AI enabling environment

The United States has consistently positioned itself as a front-runner in the advancement, research, adoption, and governance of 4IR with digital technologies such as AI. Through a comprehensive framework encompassing strategic policies, legislation, funding mechanisms, and ethical oversight, the United States has established a robust ecosystem to promote the sustainable development and responsible deployment of AI technologies. This benchmarking study explores foundational initiatives and policies implemented by the United States that serve as a valuable reference for Uganda. These insights provide a basis for developing supportive infrastructure, policies, and strategies to enable Uganda's AI and digital transformation.

5.4.1 National AI Initiative Act of 2020

The National AI Initiative Act of 2020 represents a landmark policy aimed at fostering a coordinated approach to AI development, ensuring ethical alignment, and maintaining the United States leadership in AI. The act mandates the establishment of the National Artificial Intelligence Initiative, a comprehensive national programme that emphasizes:

a) Coordination of AI research, development, and adoption: Through the establishment of the National Artificial Intelligence Office, the initiative seeks to unify federal efforts in AI, bridging public and private sector activities to accelerate AI innovation, research, and deployment. By coordinating across various government bodies, the initiative addresses technological advancements while mitigating ethical and safety concerns.

b) National Artificial Intelligence Advisory Committee: The advisory committee, tasked with advising the President and the AI Initiative Office, plays a pivotal role in guiding AI policy to ensure responsible development. It offers insights into strategic priorities, workforce needs, and regulatory frameworks, providing a holistic approach to governance and oversight in AI.

c) Research and development funding: The Act encourages AI innovation by allocating federal funding to support AI-related research and education initiatives across academic institutions, private companies, and research centres. This funding bolsters the development of cutting-edge AI systems, addresses foundational challenges, and enhances the practical reliability of AI methods and solutions.

d) Workforce development and preparedness: Recognizing the transformative impact of AI on the economy, the Act focuses on equipping the workforce in the United States for the widespread adoption of AI across various sectors. It promotes educational initiatives, technical training, and skill-building programmes to ensure that the workforce is prepared for the integration of AI in both technical and non-technical roles, fostering resilience and adaptability within the labour market.

These coordinated actions contribute to an enabling environment that not only drives AI innovation but also prioritizes ethical considerations, public welfare, and economic competitiveness. Experience in the United States, marked by this cohesive policy framework, offers Uganda a model for creating its own policies, fostering cross-sector collaboration, and developing a skilled workforce to harness the full potential of AI.

5.4.2 National Institute of Standards and Technology AI risk management framework

The National Institute of Standards and Technology (NIST) developed the AI risk management framework (AI RMF) to support organizations in identifying, assessing, and mitigating risks associated with the deployment and operation of AI systems. This voluntary framework serves as a comprehensive tool for integrating trustworthiness, ethical standards, and safety considerations into every phase of the AI system lifecycle. Its structured guidance emphasizes not only technical robustness but also social and ethical implications, aiming to ensure that AI technologies are developed and deployed responsibly and with clear risk mitigation strategies.

The AI risk management framework identifies three primary categories of potential harm that AI systems can cause, and it provides guidance on preventing and mitigating these impacts:

a) Harm to individuals: Protects individuals' rights, freedoms, and safety, ensuring AI applications do not compromise liberties, physical and psychological well-being, or access to equal opportunities. It also prioritizes democratic values and educational inclusivity.

b) Harm to organizations: Focuses on shielding organizations from operational disruptions, security vulnerabilities, and reputational damage that could arise from unintended consequences or misuse of AI technologies.

c) Harm to ecosystems: Addresses risks to broader systems, including disruptions to financial networks, supply chains, and environmental stability, ensuring AI's integration into societal infrastructure without compromising natural resources or causing ecological harm.

To systematically address these risk categories, the AI risk management framework incorporates four core functions:

a) Map: This function involves gathering comprehensive insights from all stakeholders, including internal teams, external partners, end users, and any other affected groups. By integrating diverse perspectives, organizations are better equipped to recognize and understand the full scope of AI risks within a given application.

b) Measure: The framework emphasizes the importance of rigorous testing both pre-deployment and throughout the operational phase. Regular assessment of AI systems is critical to maintaining their reliability, safety, and trustworthiness, allowing for continual adjustments as technologies and risk landscapes evolve.

c) Manage: Under this function, AI systems are managed through targeted risk treatments, with a focus on aligning resources to maximize the benefits of AI while proactively minimizing its risks. This involves operational safeguards, resource allocation, and policies that enable AI technologies to function safely within organizational contexts.

d) Govern: This function provides guidelines for establishing governance structures, policies, and accountability mechanisms that oversee the ethical, operational, and regulatory aspects of AI. It advocates for the formation of dedicated teams, systems, and processes that uphold the responsible deployment and use of AI technologies.

The AI RMF structured approach enables organizations to build resilient, secure, and socially responsible AI systems that align with global standards, while remaining adaptable to the unique demands of local environments. This structured, risk-based methodology serves as a critical point of reference for Uganda as it establishes frameworks to support AI, 4IR technology integration, and sustainable digital transformation.

5.4.3   Executive Orders on Trustworthy AI (2019-2020)

The United States Government has undertaken comprehensive efforts to ensure that AI development aligns with principles of safety, fairness, accountability, and transparency. These principles were introduced through a series of Executive Orders (EOs) aimed at establishing trustworthy AI across public and private sectors, encompassing areas such as defence, healthcare, and federal governance.

Key components in the order are:

a)   Safety and security: Recent Executive Orders have mandated that federal agencies develop AI policies prioritizing safe and secure AI use, particularly in high-stakes environments such as defence and healthcare.

b)   Ethical AI use in defence: Specific EOs address the ethical deployment of AI within defence, mandating adherence to ethical guidelines and transparency to ensure that AI applications in military contexts are responsible and aligned with democratic values.

c)   Combating algorithmic bias: These policies include initiatives to prevent algorithmic discrimination, with a focus on fair and unbiased AI applications in sectors affecting citizens' rights and opportunities, such as finance, healthcare, and employment.

d)   Government AI adoption: Guidelines have been established for the ethical use of AI in government operations, enhancing efficiency while ensuring citizens' data privacy and security. The directives encourage agencies to integrate AI in a manner that maintains public trust and safeguards civil liberties.

The approach to fostering a reliable, responsible AI ecosystem in the United States is an exemplary reference for Uganda. By considering the structural and ethical dimensions in United States policies, Uganda can adapt similar principles to create a comprehensive AI-enabling environment that aligns with both local needs and global best practices.

5.4.4   Federal Trade Commission (FTC) Guidelines on AI and Consumer Protection

The Federal Trade Commission (FTC) plays a critical role in ensuring consumer protection within the United States, including in the rapidly evolving field of AI. Recognizing both the opportunities and potential risks associated with AI, the FTC has developed guidelines to address core issues related to privacy, transparency, fairness, and accountability in AI-driven systems. These guidelines are designed to mitigate harm and uphold consumer rights, ensuring that organizations using AI technologies maintain ethical and legal standards.

The FTC guidelines underscore several key principles:

a)   Privacy protection: The FTC mandates that organizations deploying AI systems must respect consumer privacy rights by implementing robust data protection measures. Companies are advised to ensure that any data collected, processed, or shared through AI applications adheres to strict privacy standards and security protocols. This includes transparent communication with consumers regarding how their data is collected and used, as well as adopting privacy-by-design approaches in AI development.

b)   Prevention of bias and discrimination: To mitigate discrimination risks, the FTC's guidance emphasizes the need for organizations to assess and address any potential biases in AI algorithms that could lead to discriminatory outcomes based on race, gender, age, or other protected attributes. Companies are encouraged to conduct rigorous testing and validation processes to identify, measure, and rectify biases within their AI models. By

fostering fairness in AI, the FTC aims to prevent discriminatory impacts that could harm or disadvantage consumers.

c) Transparency and deceptive practices: Transparency is fundamental to the FTC approach to consumer protection in AI. Organisation are required to provide clear, accurate, and non-deceptive information about their AI system functionalities, limitations, and the manner in which they interact with consumers. The guidelines caution against misleading representations regarding AI capabilities, as well as the concealment of automated interactions to maintain transparency and trust with users.

d) Accountability in AI deployment: The FTC encourages accountability in the deployment and oversight of AI technologies. Companies deploying AI systems are urged to conduct ongoing monitoring, evaluation, and risk assessment of their AI tools to ensure compliance with legal obligations and ethical standards. Establishing internal accountability mechanisms—such as appointing dedicated compliance officers or forming ethics boards—is recommended to enhance governance and oversight in AI use.

By adhering to these guidelines, the FTC seeks to create a regulatory environment that both fosters innovation in AI and safeguards consumer interests. The FTC approach not only sets expectations for current AI applications but also aims to establish foundational standards that can evolve alongside technological advancements in AI. The guidelines serve as a critical reference point for other regulatory agencies worldwide, particularly in addressing privacy concerns, combating algorithmic discrimination, and promoting responsible AI practices in consumer interactions.

5.4.5   AI in Government Act (H.R. 2575)

This is a legislative measure aimed at promoting the responsible and effective adoption of AI technologies across federal government agencies. Central to this Act is the establishment of an AI Centre of Excellence (AI CoE), which serves as a dedicated body to guide, support, and facilitate the integration of AI within federal operations. This centre is tasked with promoting cohesive strategies and best practices to ensure consistent and competent AI adoption across various government departments.

The primary objectives of the AI CoE include:

a) Facilitating the adoption of AI technologies: The AI CoE acts as a resource and advisory body to assist federal agencies in identifying, acquiring, and implementing AI tools and systems that enhance their operational effectiveness. This role involves guiding agencies through the complex technical and ethical considerations of AI adoption, ensuring a high standard of interoperability and efficiency.

b) Enhancing competency and cohesion in AI utilization: To foster a unified approach to AI adoption, the AI CoE works to standardize practices, improve institutional knowledge, and build technical competencies among federal staff. This includes providing training, frameworks, and guidelines that allow for informed, secure, and consistent AI use across all government functions, thereby reducing duplication of efforts and creating a cohesive AI policy landscape.

c) Improving public benefit and government productivity: To ensure that AI technologies contribute positively to public service and enhance the productivity of government operations. This entails the implementation of AI solutions that improve service delivery, streamline administrative processes, and increase overall efficiency. The AI CoE also focuses on developing AI applications that align with ethical standards and public interest, maximizing AI social and economic benefits while safeguarding privacy and transparency.

d) Creating accountability and governance structures: The Act emphasizes the importance of strong governance structures to oversee AI deployment within federal agencies. This includes establishing protocols for the evaluation, monitoring, and reporting of AI use, as well as frameworks to address issues of bias, transparency, and accountability. Through these structures, the AI CoE ensures that AI applications are deployed responsibly, with safeguards to prevent misuse and mitigate potential risks.

Overall, the AI in Government Act seeks to build a robust foundation for AI-driven innovation within the federal government, allowing for technology that not only improves internal efficiencies but also generates public value. The Act serves as a model for other governments aiming to implement AI responsibly within public administration, highlighting the need for specialized institutions, cohesive strategy, and a strong ethical framework in AI governance.

5.4.6   Advancing American AI Act (S.1353)

The Advancing American AI Act (S.1353) is a comprehensive legislative effort aimed at fostering the adoption of artificial intelligence (AI) technologies within the United States Government while ensuring alignment with core American values such as privacy, civil rights, and civil liberties. This act mandates that specified federal agencies take proactive measures to incorporate AI in ways that support agency missions and address critical societal needs. Furthermore, it emphasizes the importance of a responsible and transparent approach to AI, requiring agencies to implement policies that safeguard ethical principles and minimize risks associated with AI-enabled systems.

Under this Act, agencies across the federal government, including the Department of Homeland Security (DHS), are tasked with establishing clear guidelines and procedures governing the acquisition, deployment, and oversight of AI systems. The DHS, specifically, must develop policies to assess and manage the potential impacts and risks of AI, with particular attention to the implications for public safety, privacy, and security. By issuing these guidelines, DHS aims to address risks inherent to AI technologies, including data privacy concerns, biases in AI decision-making processes, and potential threats to individual freedoms.

A key aspect of the Advancing American AI Act is its balanced approach, which encourages federal agencies to innovate and leverage AI capabilities while simultaneously implementing rigorous ethical standards and accountability measures. This approach is designed to ensure that AI applications within the federal government remain transparent, inclusive, and aligned with the values of the American public. Moreover, the act highlights the importance of inter-agency collaboration and information sharing to promote cohesive AI strategies across the government, thus supporting both individual agency goals and broader national objectives in AI.

Overall, the Advancing American AI Act represents a significant step toward a structured, ethical AI integration within United States federal agencies, balancing the pursuit of technological advancement with a strong commitment to human rights and democratic values. The act underscores the United States Government's role as both a steward of public trust in AI and a leader in the global development of ethical AI standards. Through this legislation, the United States aims to position itself as a model for responsible AI adoption, paving the way for a future where AI-driven innovation contributes to public well-being while upholding the foundational values of American society.

5.4.7   Blueprint for an AI Bill of Rights

The Blueprint for an AI Bill of Rights: Making Automated Systems Work for the American People was published by the White House Office of Science and Technology Policy in October 2022. This document outlines a set of principles and standards aimed at ensuring that automated systems especially those leveraging artificial intelligence operate fairly, transparently, and ethically, upholding the rights and interests of the American public. At its core, the blueprint addresses concerns over the potential misuse of technology, data, and automated systems in ways that could undermine individual rights and equity, particularly in a rapidly advancing AI landscape.

The blueprint advocates for the development of safe, effective, and inclusive AI systems through consistent consultation with diverse communities, stakeholders, and domain experts. This approach aims to identify and address potential risks, challenges, and societal impacts associated with these systems early in their design and deployment. The following are the key pillars of the AI Bill of Rights:

a)   Algorithmic discrimination protection: The blueprint emphasizes protections against algorithmic discrimination, ensuring AI systems are designed and implemented equitably. These protections aim to prevent bias and discrimination embedded in algorithms, promoting fairness and inclusivity in automated decision-making processes across various sectors, including healthcare, employment, education, and criminal justice.

b)   Data privacy and protection: Data privacy is central to the blueprint, advocating for robust protections against exploitative data practices. It establishes guidelines for how user data should be handled, recommending built-in privacy protections as default features in AI systems. This includes limiting data collection to only what is necessary for specific contexts, aligning with user expectations and regulatory requirements.

d)   The blueprint also stresses the importance of data autonomy, advocating for designers, developers, and deployers of automated systems obtain user consent and honour their choices regarding data collection, use, access, transfer, and deletion. In situations where explicit consent is unfeasible, privacy-by-design measures should be employed to safeguard user data.

e)   Transparency and explanation: The blueprint underscores the necessity of transparency in AI systems, mandating that users are informed when an automated system is in use. Additionally, it promotes the right to understand how and why automated decisions are made, especially when such decisions have significant implications for individuals. This approach fosters trust by ensuring that automated systems offer clear explanations for their outputs, allowing users to make informed decisions about their interactions with AI.

f)   Opt-out and human alternative options: The blueprint champions the right for users to opt out of AI-driven processes in favour of human interaction where appropriate. This principal address concerns over the potential overreach of automation by offering users a fallback to human decision-making and support, which is essential for scenarios requiring nuanced judgment or a personalized approach.

The Blueprint for an AI Bill of Rights lays the groundwork for a regulatory and ethical framework that safeguards public rights in the era of artificial intelligence. By focusing on fairness, privacy, transparency, and human-centred alternatives, it aims to create an AI ecosystem that enhances public welfare without compromising individual freedoms or equity.

5.4.8   Establishment of national AI research institutes

The establishment of national AI research institutes serves as a strategic initiative to propel advancements in foundational AI research while addressing sector-specific challenges through innovative applications. These institutes aim to develop and implement transformative AI-driven solutions across critical sectors, including cybersecurity, healthcare, agriculture, and manufacturing, to support national development objectives.

Through these institutes, the government seeks to foster a robust collaborative ecosystem, bringing together academic institutions, leading technology companies, and governmental bodies. This tripartite model ensures that research and development efforts are grounded in cutting-edge academic insights, informed by industry needs, and aligned with public policy priorities.

The focus areas within these institutes include:

a)   Cybersecurity: Developing AI applications to enhance national security by detecting, preventing, and responding to cyber threats more effectively. These efforts aim to secure critical infrastructure, safeguard sensitive data, and support the overall resilience of digital systems.

b)   Healthcare: Leveraging AI to improve diagnostics, optimize treatment pathways, and expand access to quality healthcare services. Research includes developing predictive models for disease outbreaks, enhancing telemedicine capabilities, and using AI for personalized medicine.

c)   Agriculture: Applying AI to increase agricultural productivity, reduce waste, and manage resources more sustainably. Research initiatives may involve precision farming techniques, crop disease prediction models, and supply chain optimization.

d)   Manufacturing: Promoting AI innovations to streamline production processes, enhance product quality, and improve workforce safety. Projects in this area may include predictive maintenance, robotics, and quality control through computer vision.

The national AI research institutes not only address the immediate sectoral needs but also aim to build a sustainable talent pipeline by engaging with universities and technical training institutions to equip the next generation of AI specialists. This approach helps align educational curricula with industry demands, fostering a workforce adept in AI capabilities. Furthermore, these institutes operate with a mandate to uphold ethical standards and address societal impacts, promoting AI practices that prioritize transparency, fairness, and inclusivity.

The Institute plays a pivotal role in advancing the country's AI capabilities, supporting cross-sectoral innovation, and building an environment conducive to the safe, responsible, and effective deployment of AI technologies. By conducting research and collaboration across sectors, these institutes are positioned to significantly contribute to economic growth, digital resilience, and global competitiveness.

5.4.9   Infrastructure

The Unites States has AI infrastructure comprising various foundational elements that collectively support the seamless development, deployment, and operation of AI technologies. This includes

cloud services, high-speed Internet, 5G connectivity, edge computing, and accessible data, all of which are integral to AI applications and innovation.

a) Cloud service providers such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud offer essential computational resources and storage capabilities necessary for large-scale AI development and deployment. These platforms provide scalable, on-demand infrastructure, which is especially valuable for handling intensive AI workloads. This scalability allows organizations to leverage resources according to demand, supporting everything from initial research and development to production-level deployments without the need for extensive physical hardware investments. Additionally, these providers offer specialized AI and machine learning services, pre-trained models, and advanced data processing capabilities, enhancing both speed and efficiency in AI solution development.

b) High-speed Internet, alongside 5G connectivity, is critical for enabling low-latency, high-throughput data transmission essential for real-time AI applications. This infrastructure is crucial in fields requiring rapid data transfer and processing, such as autonomous driving, augmented reality, telemedicine, and Internet of things (IoT) applications, where delays can impact outcomes. With its increased bandwidth and minimal latency, 5G technology empowers these real-time AI applications, fostering advancements in areas such as smart cities, industrial automation, and connected healthcare.

c) Edge computing brings computation and data storage closer to the source of data, minimizing latency and reducing the load on centralized data centres. Unlike traditional cloud models where data is processed in a central location, edge computing distributes computing resources to local nodes near the end users or devices, which is particularly beneficial for latency-sensitive AI applications. This decentralized approach is valuable for scenarios such as IoT, autonomous systems, and remote monitoring, where data must be processed rapidly and securely. Moreover, edge infrastructure can enhance data privacy and security by limiting the amount of sensitive information sent to the cloud, instead processing it closer to the source.

d) The availability of extensive and diverse datasets is vital for training and testing AI models. Countries that promote open data policies create environments that support AI research and innovation by making large volumes of data accessible to developers, researchers, and industry stakeholders. Publicly available datasets can include demographic information, health data (in de-identified formats), environmental statistics, and transportation data, all of which provide valuable training resources. The presence of accessible data repositories, coupled with data-sharing policies that ensure privacy and security, accelerates AI development, fostering advancements in data-driven decision-making across sectors.

These infrastructure components in the United States collectively create an enabling environment for AI innovation, supporting research, development, and deployment at all scales, from experimental models to mission-critical AI applications.

5.5   Benchmarking study of Rwanda's AI enabling environment

5.5.1   National Strategy for Transformation (NST1) 2017-2024

The strategy is a comprehensive development blueprint designed to propel the country towards sustained growth and transformation across three central pillars of economic transformation, social transformation, and transformational governance. These pillars collectively aim to establish Rwanda as a competitive, inclusive, and sustainable knowledge-based economy by enhancing both infrastructure and human capital.

Economic transformation: Under this pillar, Rwanda prioritizes the development of a digital economy, aiming to foster job creation, innovation, and the advancement of high-quality ICT

skills. The government places strong emphasis on fostering ICT-driven industries and services, recognizing them as essential to broad economic growth and competitiveness in regional and global markets. By investing in AI and related technologies, Rwanda seeks to boost productivity and position itself as a regional leader in the digital economy.

Social transformation: The social transformation pillar seeks to improve citizen well-being through equitable access to digital services and ICT-based educational programmes. Rwanda's vision emphasizes the use of AI and ICT in healthcare, education, and public services to enhance social inclusion and improve the quality of life. The strategic focus on social transformation supports Rwanda's ambition to leverage technology as a tool for addressing socio-economic disparities, promoting inclusivity, and improving service delivery across all levels of society.

Transformational governance: At the core of Rwanda's AI strategy is the transformational governance pillar, which prioritizes capacity building, service delivery, and accountability within public institutions. Rwanda aims to cultivate high-quality ICT and AI competencies across government sectors, reinforcing a knowledge-based economy through skilled human resources, a secure cyber environment, and protected national infrastructure. This pillar also supports the establishment of a robust regulatory framework for AI and ICT, focusing on digital safety, ethical standards, and transparent governance practices.

An essential precondition for achieving the objectives outlined in the national ICT strategic plan is ongoing collaboration and dialogue between the government and key stakeholders. Rwanda has established mechanisms to encourage meaningful partnerships with private sector leaders, academic institutions, and civil society organizations, ensuring that AI and ICT initiatives align with the National Strategy for Transformation. The national ICT strategic plan thus functions as a coordinated roadmap, harmonizing and integrating diverse ICT efforts across sectors to achieve the overarching goals of NST1. This cohesive approach enables Rwanda to harness ICT and AI innovations effectively, supporting the country's transformation agenda and driving prosperity for all its citizens.

Through its comprehensive strategy and focus on an enabling environment for digital transformation, Rwanda is creating a solid foundation for adopting advanced technologies such as AI, which aligns with its vision for sustainable growth and regional competitiveness.

5.5.2   The Smart Rwanda 2018-2024 ICT Sector Strategic Plan (ICT SSP)

The plan is an ambitious initiative that leverages ICT to transform Rwanda into a knowledge-based economy, fostering a digitally inclusive society and globally competitive digital infrastructure. The ICT SSP sets clear objectives to ensure that digital technologies, from broadband to AI and IoT, serve as catalysts for sustainable development, inclusivity, and economic transformation.

a)   Broadband access for All by 2024: The ICT SSP underscores broadband access as a fundamental right, positioning it as a "basic need" for every Rwandan by 2024. By establishing extensive broadband infrastructure, Rwanda aims to eliminate digital disparities, ensuring equitable access to digital resources and connectivity. This comprehensive approach seeks to bridge the digital divide across urban and rural areas, promoting digital inclusion and empowering citizens to participate fully in the digital economy.

b)   Government digital transformation by 2024: The plan envisions a complete digital transformation of government services, enabling 24/7 accessibility for citizens, businesses, and government agencies. This shift aims to streamline government transactions by

transitioning essential services online, thereby achieving efficient government-to-business (G2B), government-to-citizens (G2C), and government-to-government (G2G) interactions. The result is a citizen-centred digital government that facilitates ubiquitous service delivery and improves transparency, accountability, and responsiveness.

c)   Universal digital literacy: To become a knowledge-driven economy, Rwanda prioritizes digital literacy as a cornerstone of the ICT SSP. This commitment to digital literacy is designed to equip all Rwandans, regardless of socioeconomic or political status, with the skills needed to engage with and benefit from digital technologies. By empowering individuals with digital skills, Rwanda not only fosters individual growth but also ensures an inclusive transformation where citizens are active participants in the digital economy, contributing to social and economic development.

d)   SMART government and competitive economy: The ICT SSP aligns with the principles of the Service-oriented, Modern, Accountable, and Real-Time (SMART) Rwanda Master Plan (SRMP), establishing a forward-thinking government framework designed to drive Rwanda's global competitiveness and job creation. By fostering a SMART government, the strategy prioritizes innovation, efficiency, and accountability in governance, while also enhancing the ease of doing business to attract foreign investments and support entrepreneurial growth. This vision promotes an agile, open, and innovative economic environment that can rapidly respond to global market demands.

e)   Leveraging emerging digital technologies: The ICT SSP incorporates emerging digital technologies including Artificial Intelligence, the Internet of Things (IoT), big data and analytics, blockchain, robotics, and e-commerce as fundamental pillars in Rwanda's digital transformation. These technologies provide the backbone for a future-ready digital ecosystem, supporting data-driven decision-making, automating critical processes, and enabling the development of smart cities, digital lifestyle solutions, and a vibrant creative industry. This multi-faceted approach empowers Rwanda to become a competitive, innovative economy that fosters growth across sectors and positions itself as a leader in adopting cutting-edge digital solutions.

The Smart Rwanda ICT SSP represents a holistic, forward-looking digital strategy that combines foundational infrastructure with cutting-edge technology to achieve a knowledge-based, inclusive, and competitive economy. Rwanda's approach serves as an instructive model, illustrating how strategic planning, technology adoption, and policy-driven initiatives can catalyse economic transformation and empower citizens on the path to a digital future.

5.5.3   The National Artificial Intelligence Policy

Rwanda's National Artificial Intelligence Policy serves as a strategic framework designed to accelerate the nation's socio-economic transformation through inclusive and sustainable AI integration. This policy aims to harness the transformative potential of AI to drive economic growth, enhance quality of life, and position Rwanda as a global leader in responsible and inclusive AI practices. By establishing a clear vision for AI, Rwanda seeks to become a leading African innovation hub and Africa's Centre of Excellence in AI, attracting investment, fostering talent, and spurring technological advancements.

The policy emphasizes AI-driven innovation across key sectors critical to Rwanda's development agenda, including education, healthcare, agriculture, manufacturing, construction, and finance. By promoting AI adoption in these areas, the government aims to enhance productivity, streamline operations, and introduce new services that benefit both the economy and Rwandan society. For instance, in healthcare, AI applications are leveraged for disease detection and predictive analytics, improving diagnostic accuracy and patient outcomes. In agriculture, AI

supports precision farming practices, enhancing food security through optimized resource use and productivity.

To ensure that AI development aligns with ethical standards, the policy integrates a framework for privacy, security, transparency, and fairness in AI systems. This ethical foundation is designed to protect individual rights while fostering public trust, which is essential for widespread AI adoption. Rwanda's policy mandates that all AI-driven innovations adhere to guidelines that safeguard data privacy, prevent algorithmic bias, and promote inclusivity to ensure equitable benefits across society.

Additionally, the National AI Policy is structured to build Rwanda's capacity in AI research and development by fostering collaborations between the public sector, academia, and private industries. Through partnerships and targeted investments, Rwanda is nurturing a skilled workforce and research community equipped to advance AI technologies responsibly. This integrated approach ensures that AI adoption is not only innovative but also contributes to Rwanda's overarching goals of sustainable and inclusive socio-economic progress.

5.5.4   Capacity building and education

Building and education that spans academia, industry, and government initiatives. Recognizing the critical role of skilled professionals in advancing AI and data science, Rwanda has integrated AI-focused curricula into its higher education system and fostered partnerships with prominent international organizations, such as the World Economic Forum (WEF) and the Centre for the Fourth Industrial Revolution (C4IR). These collaborations have allowed Rwanda to access global expertise, resources, and best practices, accelerating local talent development and strengthening the country's AI ecosystem.

Rwanda's approach includes structured programmes within universities to build foundational and advanced competencies in AI and data science, incorporating practical and theoretical learning to ensure graduates are industry ready. In addition to university programmes, the country supports specialized training and certification opportunities for professionals through various governmental and non-governmental initiatives. These initiatives often emphasize applied skills, targeting high-demand areas such as machine learning, natural language processing, and data analytics.

Moreover, Rwanda's government has facilitated industry partnerships to provide internships, workshops, and mentorship opportunities, enhancing hands-on experience and fostering a culture of innovation and entrepreneurship. Programmes targeting youth and women are also prioritized, ensuring diversity and broad participation in the AI sector, which aligns with Rwanda's overarching digital transformation goals. These efforts are supported by incentives to attract international educators and researchers, promoting knowledge transfer and fostering a globally competitive AI talent pool.

Rwanda's robust capacity-building framework demonstrates its commitment to equipping its workforce with the expertise needed to advance AI-driven economic and social initiatives, positioning the country as a model for AI talent development in emerging economies. Through sustained investment in education and strategic partnerships, Rwanda aims to empower a generation capable of driving innovation in AI and related 4IR technologies, facilitating the country's ambitious digital transformation agenda.

5.5.5   Kigali Innovation City

Kigali Innovation City (KIC) is a flagship initiative by the Rwandan government aimed at establishing Rwanda as a leading innovation hub in Africa. Positioned within Kigali's Special Economic Zone, KIC is a model for fostering growth in emerging technologies, including artificial intelligence (AI), robotics, blockchain, and other 4IR technologies. The city is structured to attract international investors, academic institutions, and technology firms, creating a highly conducive ecosystem for research, development, and commercialization of advanced digital technologies.

As a centre for innovation, KIC offers state-of-the-art infrastructure tailored to support the full lifecycle of tech-based companies from startups to mature enterprises. Its facilities include dedicated incubation spaces, office complexes, and flexible workspaces that provide a supportive environment for innovation. These resources are essential for nurturing talent, promoting entrepreneurial growth, and driving impactful R&D projects. KIC also houses specialized labs, research centres, and maker spaces, providing technology developers and researchers with the tools needed to push boundaries in AI and related fields.

A distinctive feature of KIC is its emphasis on collaboration and cross-industry synergies. Positioned within a Special Economic Zone, KIC facilitates unique partnerships by offering benefits such as tax incentives, streamlined regulatory frameworks, and enhanced access to international markets. This strategic positioning encourages alliances among firms working in IoT, machine learning, and data analytics, promoting cross-sector innovations that can power Rwanda's digital transformation and enhance its competitiveness globally.

Furthermore, KIC aims to advance human capital development by working closely with universities and vocational institutions, establishing itself as a centre of excellence for digital skills training and AI capability-building in Africa. Through these partnerships, KIC supports programmes that bridge the digital skills gap, equipping Rwanda's workforce with the expertise needed for 4IR careers. This focus on talent development is central to KIC's vision of building a sustainable, innovation-driven economy, positioning Rwanda as a pioneer in Africa's digital revolution.

5.5.6   Rwanda Data Protection and Privacy Law, 2021

The Rwanda Data Protection and Privacy Law, 2021 serves as a crucial legislative framework that safeguards personal data and upholds the privacy rights of individuals within the context of an increasingly digital society. This law establishes comprehensive regulations governing the collection, storage, and processing of personal data, thereby creating a robust foundation for the responsible use of data in the deployment of Artificial Intelligence (AI) systems and 4IR technologies.

The law mandates that all entities involved in data processing must operate with a high degree of transparency and accountability. It requires organizations to clearly communicate their data collection practices and the purposes for which personal information is utilized. This commitment to transparency not only fosters public trust but also empowers individuals by giving them the right to access their personal data, correct inaccuracies, and request deletion when necessary.

Moreover, the Rwanda Data Protection and Privacy Law emphasizes the importance of data security, mandating that organizations implement appropriate technical and organizational measures to protect personal data from unauthorized access, misuse, or breaches. This

requirement is particularly relevant in the context of AI, where vast amounts of personal information are often processed to train algorithms and inform decision-making. By establishing strict security protocols, the law aims to mitigate risks associated with data breaches and ensure that individual privacy is maintained throughout the data lifecycle.

In addition to these provisions, the law outlines specific responsibilities for data controllers and processors, holding them accountable for ensuring compliance with data protection principles. This includes the necessity of conducting data protection impact assessments to evaluate the risks associated with data processing activities, particularly when implementing new AI technologies. Such assessments are vital for identifying potential privacy risks and ensuring that appropriate safeguards are in place.

The legal framework also provides for the establishment of an independent regulatory authority tasked with overseeing data protection compliance. This authority plays a pivotal role in enforcing the law, investigating complaints, and providing guidance to organizations on best practices for data handling. By fostering a culture of accountability and compliance, the regulatory authority helps to create an environment conducive to the ethical use of AI and data-driven technologies.

In summary, the Rwanda Data Protection and Privacy Law, 2021, represents a significant step towards establishing a secure and privacy-centric digital ecosystem. By ensuring that AI systems and 4IR technologies adhere to stringent data protection standards, this law not only protects individuals from data misuse but also promotes responsible innovation. In doing so, it supports Rwanda's broader ambitions to leverage AI and technology as drivers of economic growth and social development while safeguarding fundamental human rights.

5.5.7   Rwanda's AI infrastructure

Rwanda has made significant strides in developing a conducive infrastructure for artificial intelligence (AI), characterized by its commitment to enhancing Internet connectivity, expanding broadband access, and establishing data centres that support digital innovation. The country recognizes that a robust AI infrastructure is essential for fostering technological growth and creating an enabling environment for AI applications across various sectors.

a)   Internet penetration and connectivity: As of recent data, Rwanda boasts of an Internet penetration rate of approximately 44.67 per cent. This figure reflects the government's efforts to increase access to digital services and bridge the digital divide within the population. However, to fully leverage the potential of AI technologies, continued investment in expanding Internet accessibility, particularly in rural and underserved areas, is crucial. Initiatives aimed at enhancing connectivity will play a pivotal role in enabling wider access to AI tools and resources, fostering innovation, and promoting digital literacy.

b)   Broadband connection speed: The average broadband connection speed in Rwanda is currently measured at 48.12 kbits/s (Statista, 2024). While this represents an improvement in overall connectivity, it still falls short of the higher speeds necessary for seamless AI operations, particularly those requiring real-time data processing and analysis. To support AI-driven applications, such as smart city technologies and remote health monitoring systems, investments in upgrading broadband infrastructure and expanding high-speed Internet access are essential. Initiatives to enhance network capacity and speed will facilitate the deployment of advanced AI solutions and improve the user experience across digital platforms.

c)   Rwandan East Africa Data Centre: The establishment of the Rwandan East Africa Data Centre marks a significant milestone in the country's AI infrastructure development. This facility serves as a critical hub for data storage, processing, and management, enabling

businesses and governmental institutions to harness data-driven insights effectively. The data centre supports a range of services, including cloud computing and big data analytics, thereby facilitating the deployment of AI applications across various sectors, such as agriculture, healthcare, and education. By providing a localized solution for data management, the East Africa Data Centre enhances Rwanda's capacity to host AI applications securely while minimizing latency and improving overall operational efficiency.

AI infrastructure reflects a commitment to building a foundation for technological advancement. However, to optimize the enabling environment for AI, continuous efforts to enhance Internet penetration, upgrade broadband speeds, and expand data centre capabilities are essential. These advancements will not only bolster Rwanda's position as a leader in the region's digital transformation but also facilitate the integration of AI technologies into critical sectors, driving sustainable economic growth and innovation.

5.6   Benchmarking study of Kenya's AI enabling environment

5.6.1   National ICT Policy

Kenya's National ICT Policy serves as the cornerstone of its digital transformation agenda, providing a strategic framework that mandates all levels of government to develop, deploy, and manage locally built backend and frontend systems to enhance public service delivery. The policy is designed to unlock the full potential of Kenya's digital economy by establishing an inclusive environment for all citizens and stakeholders, fostering innovation, and promoting economic growth through ICT.

The ICT Policy outlines a progressive, forward-looking approach, addressing key components of the rapidly evolving ICT landscape to position Kenya as a leader in digital transformation. The main objectives include:

a)   Building high-speed infrastructure: The policy emphasizes the establishment of infrastructure that supports high-speed, always-on wireless Internet across the country, enabling connectivity that is critical for both urban and rural areas. This objective ensures accessibility and inclusivity, reducing the digital divide and facilitating e-services and digital literacy.

b)   Supporting data centres and emerging technologies: Recognizing the significance of data and advanced technology, the policy provides frameworks to foster the growth of data centres, support pervasive IoT instrumentation, and enable machine learning applications. This objective also prioritizes local manufacturing to promote Kenya's digital sovereignty and reduce reliance on foreign-built systems, ensuring a secure, resilient digital ecosystem.

c)   Enhancing economic contribution of ICT: Aiming to increase ICT contribution to the national GDP to 10 per cent by 2030, the policy promotes ICT as an essential driver of economic growth. By leveraging ICT in various sectors, the policy envisions creating sustainable livelihoods, generating new income streams, and reducing unemployment rates, thereby establishing ICT as a core component of Kenya's economic foundation.

d)   Leveraging international and regional cooperation: The policy highlights the importance of engaging in regional and global partnerships to harness international opportunities. By positioning itself within the global digital economy, Kenya aims to benefit from knowledge exchange, investment, and the latest technological advancements, ultimately reinforcing its competitive advantage on the world stage.

e)   Fostering a skills-based, innovative workforce: Recognizing emerging trends such as the gig, or sharing, economy, the policy focuses on enhancing educational institutions

and aligning skill development with the demands of the digital economy. This includes fostering an ecosystem where innovation and startups can thrive on a global scale, ensuring that Kenya's workforce is prepared to lead in emerging fields like AI, blockchain, and digital entrepreneurship.

f) Achieving global recognition in public service innovation: By promoting efficiency, quality, and innovation in public service delivery, Kenya seeks to establish itself as a model for digital governance and public sector innovation. The policy envisions seamless, citizen-centric services, setting new standards in transparency, accountability, and operational excellence.

Through these objectives, Kenya's National ICT Policy positions the country to leverage ICT for broad-based economic growth and societal benefit, setting a foundation for a dynamic, inclusive, and sustainable digital economy.

5.6.2   Digital economy blueprint

Kenya's Digital Economy Blueprint is a strategic framework aimed at driving economic growth by harnessing digital technologies and fostering a digitally inclusive society. It envisions a nation where every citizen, enterprise, and organization have equal access to digital resources, possesses the necessary skills, and can fully participate and thrive within the digital economy. This blueprint serves as a guiding document to build a robust, resilient digital ecosystem that leverages emerging technologies to spur innovation, enhance productivity, and facilitate sustainable development.

The blueprint is structured around five foundational pillars that support the development and expansion of the digital economy, specifically:

a) Digital government: This pillar emphasizes digitizing government operations and public services to increase efficiency, transparency, and accessibility. Through e-government services, citizens are empowered with access to resources and information, fostering accountability and enabling Kenya's vision of a more responsive government.

b) Digital business: The blueprint promotes an environment that facilitates digital commerce and supports small and medium enterprises (SMEs) in their adoption of digital tools. By enhancing the digital capacity of businesses, Kenya aims to integrate digital solutions into the economy, improve operational efficiency, and broaden market access locally and internationally.

c) Infrastructure: Robust digital infrastructure is the backbone of Kenya's digital economy. This includes investing in reliable, high-speed Internet, data centres, and cloud services, alongside ensuring cybersecurity. The focus on infrastructure supports uninterrupted connectivity and secure platforms necessary for digital growth and innovation.

d) Innovation-driven entrepreneurship: Recognizing the role of innovation in economic transformation, this pillar fosters a culture of entrepreneurship powered by digital technology. Kenya supports innovation hubs, incubators, and tech start-ups, encouraging the development of AI, IoT, blockchain, and other advanced technologies to address local and global challenges.

e) Digital skills and values: To cultivate a digitally skilled workforce, Kenya's blueprint prioritizes education and training programmes that equip citizens with essential digital skills. This encompasses technical skills for emerging technologies and ethical values that support responsible digital citizenship.

The blueprint specifically underscores the transformative potential of disruptive technologies such as AI, robotics, blockchain, drones, IoT, big data, and software-enabled industrial platforms. By focusing on these technologies, Kenya aims to drive innovation that can significantly impact

economic development. This includes creating new industries, enhancing existing sectors, and fostering job creation, ultimately positioning Kenya as a leader in the African digital economy.

Through these pillars, Kenya's Digital Economy Blueprint establishes a comprehensive framework that not only addresses immediate needs but also lays the groundwork for future advancements, ensuring that digital innovation remains a central driver of the country's economic growth and social progress.

5.6.3   Taskforce on blockchain and AI

Kenya's establishment of a task force on blockchain and AI represents a proactive approach to exploring and harnessing the transformative potential of emerging technologies. The task force was launched to advise the government on strategic adoption, regulation, and integration of both blockchain and AI technologies into Kenya's socio-economic framework. The core mandate of this task force includes identifying opportunities and potential challenges associated with these technologies, developing actionable recommendations, and creating a roadmap for their application across various sectors critical to national development.

The task force's work is centred on areas with significant potential for impact, including:

a)   Financial inclusion: Exploring how blockchain and AI can drive greater accessibility to financial services, especially for underserved and unbanked populations, by improving transparency, reducing costs, and enhancing security in financial transactions.

b)   Cybersecurity: Assessing the role of AI in identifying and mitigating cybersecurity threats, as well as leveraging blockchain for secure data storage and transaction validation, thereby enhancing the nation's cybersecurity resilience.

c)   Healthcare: Identifying applications of AI for diagnostics, patient management, and predictive analytics, along with potential for blockchain to create secure, interoperable electronic health records that enhance data security and patient privacy.

d)   Land titling: Leveraging blockchain for transparent and tamper-proof land records to address issues of fraud, corruption, and inefficiencies in the land registration and titling processes, ensuring a more reliable property ownership system.

e)   Election process: Evaluating the use of blockchain for secure voting systems to foster transparency and trust in electoral processes, as well as AI applications in managing voter databases, predicting voter turnout, and safeguarding electoral data.

f)   Supply chain: Applying blockchain to enhance traceability and transparency across supply chains, coupled with AI to optimize logistics, inventory management, and demand forecasting.

Through this comprehensive, cross-sector approach, the task force aims to ensure that Kenya not only adopts these technologies responsibly but also develops a regulatory framework that mitigates associated risks. By promoting a structured and sector-specific integration, the task force roadmap will serve as a guide for both public and private entities on how best to leverage blockchain and AI to drive economic growth, enhance public trust, and improve service delivery in Kenya. This initiative underscores Kenya's commitment to fostering an enabling environment for innovation, ensuring that technological advancements translate into tangible societal benefits.

5.6.4   Konza Technopolis

The regional hub for research, innovation, and technology-driven economic growth, Konza Technopolis is positioned as a centre of excellence in emerging technologies such as AI, robotics, and the IoT, Konza aims to attract global and local companies focused on research and development in 4IR technologies. This ambitious project aligns with Kenya's broader objectives to advance technological capabilities, drive digital transformation, and support sustainable economic growth by fostering an innovation-friendly ecosystem.

The Konza infrastructure leverages an extensive network of smart devices, sensors, and IoT systems embedded throughout the urban environment, including in roadways, buildings, and essential public assets. These smart systems collect and transmit data in real time, creating a continuously updated digital picture of city operations and the needs of its residents. This data is aggregated and analysed through advanced smart communication networks and AI-driven software platforms, generating actionable insights that drive optimized, data-enhanced services for Konza's population.

For instance, sensors installed in roadways can monitor real-time traffic patterns, detecting the flow of pedestrian and vehicle traffic and enabling automated adjustments to traffic light timings to optimize traffic movement and reduce congestion. Similarly, air quality sensors and environmental monitoring systems can provide data on pollution levels and climate conditions, informing policies to enhance public health and environmental sustainability. Konza also plans to integrate smart building systems capable of managing energy usage efficiently, adjusting lighting, heating, and cooling systems based on occupancy and environmental factors, further reducing the energy footprint of the city.

Furthermore, Konza Technopolis is structured to foster a culture of collaborative innovation, providing an ecosystem conducive to partnerships among academic institutions, technology firms, and government agencies. With dedicated zones for research, development, and prototyping, Konza offers unique opportunities for tech companies, startups, and researchers to pilot emerging solutions in a real-world smart city environment. This environment is enhanced by policy incentives, including tax breaks and streamlined regulatory processes designed to attract investment and drive technological advancements.

Ultimately, Konza Technopolis embodies Kenya's commitment to developing a sophisticated AI and 4IR-enabled ecosystem that supports sustainable urban living, advanced research capabilities, and economic growth. The Konza project sets a valuable precedent for how well-planned, tech-driven smart cities can drive innovation and societal benefits, offering critical insights into the infrastructure, policy, and operational frameworks needed for similar projects across the region.

5.6.5   Kenya Digital Master Plan 2022-2032

Kenya's Digital Master Plan 2022-2032 presents a comprehensive framework aimed at driving the country's digital transformation by integrating 4IR technologies, including AI, blockchain, IoT, and big data, into key sectors of the economy. This master plan establishes ambitious, long-term objectives for leveraging these advanced technologies to foster economic growth, improve public services, and enhance overall societal well-being.

The Master Plan sets out a decade-long roadmap that focuses on critical components needed for a successful 4IR transition. A primary emphasis is placed on infrastructure development to ensure that the foundational technological elements, such as high-speed Internet, cloud computing, and data centres, are in place to support AI and other digital technologies. This infrastructure development is intended to support both urban and rural areas, promoting balanced digital growth that addresses existing disparities.

A second pillar of the plan is capacity building, with initiatives dedicated to upskilling Kenya's workforce in digital literacy and advanced technology skills. The Master Plan recognizes that human resource capacity is essential to achieving widespread adoption of AI and 4IR technologies, emphasizing the need for training programmes and partnerships with educational institutions. By fostering a highly skilled workforce, the plan seeks to create a sustainable talent pipeline that can drive innovation and competitiveness in the digital economy.

The framework also highlights digital inclusion and equitable access as core objectives. Policies under the Master Plan aim to make digital services accessible to all Kenyans, irrespective of socioeconomic background or geographic location. This includes programmes to ensure affordable Internet access, initiatives to close the digital divide, and efforts to support marginalized communities in harnessing the benefits of AI and other 4IR technologies. The government is committed to fostering an inclusive digital society, with particular attention given to supporting vulnerable groups, such as women, youth, and rural populations, in engaging with digital resources.

In addition, the Master Plan provides guidance on policy and regulatory development necessary to support emerging technologies. By setting regulatory standards and establishing governance frameworks, the plan seeks to create a secure and supportive environment that promotes responsible AI use while safeguarding data privacy and ethics. Kenya's regulatory initiatives under the Master Plan include data protection laws, guidelines for AI use, and standards for blockchain and IoT, all designed to create a balanced, enabling ecosystem for 4IR technology.

Overall, Kenya's Digital Master Plan 2022-2032 serves as a blueprint for integrating AI and other 4IR technologies in a way that drives inclusive economic growth, builds human capital, and establishes a robust digital infrastructure. This strategic approach positions Kenya to be a leader in Africa's digital economy while ensuring that the benefits of the digital age reach every citizen.

5.6.6   Kenya National AI Strategy

The Kenya National AI Strategy offers a comprehensive framework for governing the development, application, and oversight of AI technologies across various sectors, including governance, healthcare, agriculture, education, and finance. This strategy reflects a forward-looking approach that seeks to harness AI potential for socioeconomic development while addressing the ethical, legal, and societal challenges associated with AI deployment.

The core objectives of Kenya's AI strategy are to foster an inclusive and collaborative environment, enhance sector-specific applications, and establish safeguards to ensure the ethical, fair, and responsible use of AI. By promoting inclusivity, Kenya aims to make AI technology accessible and beneficial to all sectors of society, particularly underserved communities and regions. This inclusivity is further supported by collaboration across government entities, private organizations, academic institutions, and civil society, ensuring that AI development benefits from diverse insights and expertise.

Ethical considerations are also central to Kenya's National AI Strategy, with a strong focus on developing and implementing AI systems that respect user privacy, promote transparency, and uphold principles of fairness. The strategy advocates the adoption of AI models that are not only innovative but also ethical, ensuring equitable access to AI-driven opportunities and resources. Privacy protections are embedded into the framework to safeguard individual data rights and promote public trust in AI technologies.

Kenya's National AI Strategy also emphasizes the need for a regulatory framework that adapts to the evolving nature of AI. This includes guidelines for risk management, accountability, and oversight mechanisms to monitor the deployment of AI across sectors. By providing clear policies and a structured approach to AI governance, Kenya's strategy lays the groundwork for AI's responsible and sustainable growth, positioning the country as a regional leader in AI adoption and innovation.

5.6.7   Code of practice for AI applications – Draft by the Kenya Bureau of Standards (KEBS)

The Kenya Bureau of Standards (KEBS) has developed a draft Code of Practice for AI Applications, a significant step toward establishing a formalized framework for responsible AI development and deployment within the country. This code provides comprehensive guidelines and recommendations to organizations developing, providing, or utilizing AI systems, ensuring that these systems are designed, implemented, and managed responsibly. The code emphasizes adherence to ethical standards, alignment with best practices, and prioritization of user safety and privacy, aiming to support AI adoption across sectors while minimizing potential risks.

The draft code outlines clear roles and responsibilities for a broad range of AI stakeholders, categorizing them into groups such as AI producers, data providers, developers, application providers, and end-users. By defining stakeholder roles, the code facilitates coordinated responsibility-sharing across the AI lifecycle, from design and development to implementation, usage, and decommissioning. It ensures that each group understands its obligations, promoting accountability and collaboration to advance AI integrity and ethical standards.

Additionally, the KEBS code of practice proposes a structured risk management framework that organizations can use to proactively identify, assess, and mitigate potential risks associated with AI systems. This framework addresses key risks throughout an AI system lifecycle, covering aspects such as data quality, system transparency, fairness, and user impact. The risk management approach is designed to adapt to AI dynamic nature, encouraging continuous monitoring and improvement to safeguard against emerging risks and enhance public trust in AI technologies.

Overall, this draft Code of Practice for AI Applications reflects Kenya's commitment to creating a robust AI ecosystem that balances innovation with ethical and regulatory oversight. By setting these standards, KEBS provides a foundation for responsible AI growth, encouraging the adoption of practices that protect users and promote transparency, fairness, and inclusivity across all AI applications.

5.6.8   Kenya Data Protection Act, 2019

The Kenya Data Protection Act of 2019 establishes a comprehensive legal framework for data protection and privacy, aligning Kenya's standards with international data protection regulations, such as the European Union General Data Protection Regulation (GDPR). This Act underscores

Kenya's commitment to safeguarding individuals' data privacy rights by regulating the collection, storage, processing, and sharing of personal data. It defines the roles and responsibilities of data controllers and data processors, setting stringent obligations on how personal data must be handled to ensure integrity, security, and confidentiality.

Key provisions of the Act include the requirement for data controllers and processors to obtain informed consent before collecting or processing personal data. The Act mandates that data must be collected for specified, explicit, and legitimate purposes, and prohibits further processing in a manner incompatible with those purposes. Additionally, data controllers and processors must implement technical and organizational measures to secure data against unauthorized access, accidental loss, or destruction, aligning with best practices in data security.

The Act also grants data subjects several rights, including the right to access their personal data, correct inaccuracies, and withdraw consent. The right to object to data processing and demand deletion or restriction of data further strengthens an individual's control over their personal information. Furthermore, the Act introduced the Office of the Data Protection Commissioner (ODPC), an independent regulatory authority tasked with monitoring compliance, investigating complaints, and enforcing penalties for non-compliance.

The Kenya Data Protection Act of 2019 represents a pivotal step in establishing a secure, trustworthy environment for AI and digital transformation. By ensuring data privacy and accountability, the Act creates a robust foundation that encourages innovation while protecting individuals' rights, fostering a responsible AI and data ecosystem in Kenya.

5.6.9   AI-enabling infrastructure in Kenya

Kenya's AI-enabling infrastructure demonstrates a strong commitment to advancing digital transformation through strategic investments in data centres, Internet accessibility, and fibre-optic networks, as well as promoting open data initiatives that encourage data-driven innovation.

a)   Data centres: Kenya has established significant data centre capacity to support AI and other advanced digital technologies. Notably, IXAfrica's hyperscale, carrier-neutral data centre serves as a critical infrastructure for large-scale data storage and processing. It is AI-ready, meaning it provides the computational and storage power required for complex AI applications. Liquid Telecom also offers state-of-the-art data centre facilities in Kenya, providing high reliability, security, and scalability. These centres facilitate a robust data ecosystem that can support not only local but also regional AI projects, addressing the growing demand for data processing power and reducing latency by keeping data closer to its source.

b)   Internet penetration: Kenya's Internet penetration rate, currently at 40.8 per cent (Digital, 2024; KeIGF, 2024), marks considerable progress in expanding access to digital services, although there is still room for improvement to fully enable AI-driven applications across the country. Internet access is fundamental for digital inclusion, and continued expansion efforts are essential for a comprehensive AI adoption environment. As connectivity reaches more urban and rural areas, it enhances the accessibility of digital services, contributing to the effectiveness of AI applications in areas such as e-health, e-commerce, and online education.

c)   Investment in optical fibre and 4G network: Kenya has prioritized investment in fibre-optic infrastructure, achieving a rollout of over 8 419 kilometres of fibre, with an ambitious target of 100 000 kilometres (Capital Business, 2024). These fibre networks provide high-speed Internet that is foundational for the reliable, high-bandwidth connectivity necessary for real-time AI applications. Furthermore, the extensive deployment of 4G networks

enhances mobile Internet access, enabling AI-driven mobile applications in sectors such as mobile banking, agriculture, and telemedicine. These investments lay strong groundwork for the anticipated rollout of 5G, which will further empower AI capabilities.

d) Open Data Initiative: Kenya's Open Data Initiative promotes the availability of diverse datasets in sectors including health, education, and infrastructure. By making these datasets publicly accessible, Kenya supports AI innovation by providing essential resources for model training and testing. This initiative fosters a collaborative data-sharing environment where public and private entities can leverage data for AI research, development, and deployment, driving data-driven solutions across sectors. This open data policy also enhances transparency and encourages innovation by allowing developers and researchers to create AI models tailored to the local context, which can address Kenya-specific challenges.

Through the development of these key infrastructure components, Kenya is creating an enabling environment for AI and digital transformation. These initiatives collectively support research and innovation, provide foundational digital resources, and enable scalable, data-driven solutions that can propel Kenya toward becoming a regional AI and technology hub.

5.7 Benchmarking study of Uganda on AI enabling environment

5.7.1 Innovation Hub

Uganda's Innovation Hub serves as a central pillar in the establishment of a robust ICT innovation ecosystem, fostering the development of digital products tailored to local needs while integrating globally competitive standards. Designed to support the entire innovation lifecycle, the hub facilitates ideation, incubation, and acceleration of digital solutions, with a strong focus on fostering AI-driven applications and technology.

a) Co-working and shared services: The Innovation Hub offers state-of-the-art co-working spaces tailored to the requirements of technology innovators and entrepreneurs. Equipped with high-speed Internet, dedicated workstations, and specialized hardware resources, the hub ensures that innovators have access to essential tools without the burden of costly infrastructure. This environment promotes collaboration and learning among a community of like-minded entrepreneurs, developers, and researchers, enhancing cross-disciplinary innovation and peer-to-peer knowledge sharing. In addition, networking events, workshops, and seminars are held regularly, further enriching the collaborative spirit and creating opportunities for strategic partnerships.

b) Incubation support services: The incubation arm of the Innovation Hub provides critical resources to early-stage startups, guiding them from concept development to product launch. With access to seasoned mentors and industry experts, startups receive targeted support on technical development, market research, business modelling, and intellectual property management. The mentorship network is composed of professionals from both the public and private sectors, fostering a well-rounded perspective that bridges gaps between technology and market applicability. This incubation process is particularly crucial for AI-based startups, which often require specialized guidance on data privacy, model training, and ethical AI considerations.

c) Acceleration services: For startups with a minimum viable product and a validated business model, the hub acceleration programme provides advanced resources to expedite growth and prepare for scale. This includes support in securing funding, refining go-to-market strategies and connecting with investors and corporate partners. The acceleration programme is structured to address the unique challenges of scaling AI technologies, such as ensuring model robustness, optimizing computational efficiency, and navigating regulatory frameworks. Additionally, access to investors, venture capital, and funding

opportunities is facilitated to ensure that startups with high-growth potential can expand regionally and internationally.

d) Through this structured approach, Uganda's Innovation Hub aims to cultivate a sustainable ecosystem where digital solutions, including AI-powered innovations, can thrive and contribute to the country's socio-economic development. The hub's efforts directly align with national goals of digital transformation, providing an enabling environment that drives technological advancements and positions Uganda as a competitive player in the global AI landscape.

5.7.2   Data Protection and Privacy Regulation, 2021

The Data Protection and Privacy Regulation of 2021 is a significant legislative framework aimed at safeguarding individuals' privacy and personal data within Uganda. It establishes comprehensive guidelines to regulate the collection, processing, and storage of personal information by various entities, including government bodies, private sector organizations, and data handlers.

The primary objective of this regulation is to protect the fundamental rights and freedoms of individuals concerning their personal data. It seeks to create a balanced environment where the need for data collection and processing for legitimate purposes such as public health, security, and commercial interests do not infringe upon the privacy rights of individuals. The regulation articulates clear principles for data collection, including fairness, transparency, purpose limitation, data minimization, and the necessity of obtaining informed consent from data subjects prior to the collection or processing of their personal information.

a) Rights of data subjects: The regulation delineates the rights of individuals whose data is being collected. These rights include:

– Right to Access: Individuals have the right to request access to their personal data held by data controllers.

– Right to Rectification: Individuals can demand the correction of inaccurate or incomplete data.

– Right to Erasure: Under certain circumstances, individuals may request the deletion of their personal data.

– Right to Data Portability: This allows individuals to transfer their personal data between different service providers easily.

– Right to Object: Individuals can object to the processing of their data under specific conditions, particularly when it pertains to direct marketing.

b) Obligations of data collectors, processors, and controllers: The regulation imposes stringent obligations on those who collect, process, or control personal data. Data controllers must implement appropriate technical and organizational measures to ensure data protection by design and by default. They are also required to maintain comprehensive records of data processing activities, conduct impact assessments when necessary, and report any data breaches to the relevant authorities and affected individuals promptly.

c) Regulation of data use and disclosure: The Data Protection and Privacy Regulations establish strict guidelines governing the use and disclosure of personal information. Data may only be processed for legitimate purposes and in compliance with the regulation. The unauthorized sharing or sale of personal data is prohibited, and data controllers must ensure that any third party to whom data is disclosed adhere to the same standards of data protection.

d) Enforcement and compliance: To ensure compliance with the regulation, the regulations grant the Data Protection Authority the authority to oversee and enforce data protection laws. The Authority is responsible for investigating complaints, conducting audits, and imposing penalties for non-compliance. This governance framework enhances accountability and fosters public trust in data handling practices.

e) Relevance to AI development: As AI technologies increasingly rely on large datasets, including personal information, the Data Protection and Privacy Regulations are pivotal in shaping the AI landscape in Uganda. By establishing a robust framework for data protection, the regulation not only protects individual rights but also promotes responsible data practices that are essential for the ethical development and deployment of AI solutions. This regulatory environment encourages innovation while safeguarding the privacy and security of individuals, thus laying a solid foundation for a sustainable AI ecosystem in Uganda.

The Data Protection and Privacy Regulations, 2021 represents a critical step in establishing a comprehensive legal framework that supports the ethical collection and use of personal data in the context of AI development, ensuring that Uganda can harness the benefits of AI technologies while respecting the rights of its citizens.

5.7.3   Establishment of the National 4IR Strategy Task Force

A national expert task force on 4IR was established in 2018 with the following strategic objectives:

a) Enhance the deployment and use of 4IR technologies in Uganda's key economic sectors to drive productivity, value addition and commercialization.

b) Build a strong, healthy, knowledgeable and productive population by leveraging emerging technologies.

c) Generate jobs through digitally traded exported services, automated financial services and digitally augmented logistics and trade.

d) Leverage 4IR technologies in the establishment of smart cities and the management of critical resources.

e) Transform government performance and service delivery for improved standards of living, quality of life and well-being.

f) Strengthen and stimulate research and innovation in 4IR.

g) Support national security in the physical and digital worlds.

With these Uganda's vision is to become a continental 4IR hub that enable a smart and connected Ugandan society. The mission being to transform and accelerate Uganda's development into an innovative, productive and competitive society using 4IR technologies by 2040.

The strategy report which is to advise government on the key areas for domestication of 4IR technologies and the imperatives for realizing and scaling these opportunities safely was handed to the Prime Minister for action.

5.7.4   Infrastructure

Enabling environment that promotes innovation and integration of AI technologies across various sectors. The following have been achieved towards infrastructure development to enhance the country's capacity for AI integration.

a) National Data Centre at NITA-U: The NITA-U operates the National Data Centre, which serves as a critical hub for data management and storage. This facility plays a pivotal

role in enhancing the country's data infrastructure, providing secure and reliable services for government agencies and other stakeholders. The data centre supports various applications and services, facilitating efficient data processing and management necessary for AI operations. By leveraging state-of-the-art technologies, the National Data Centre enables the storage and analysis of large datasets, essential for training AI models and driving data-driven decision-making across government and industry.

b) Internet connectivity: With an Internet penetration rate of approximately 70 per cent, Uganda has made significant strides in improving its connectivity landscape. This level of penetration is indicative of a growing digital ecosystem that enables broader access to online resources, platforms, and services. Enhanced Internet connectivity is vital for the deployment of AI applications, as it facilitates seamless data transfer and communication between devices and systems. Continued investment in expanding Internet access, particularly in rural and underserved areas, is crucial for ensuring that all citizens and businesses can benefit from AI technologies.

c) The implementation of the National Data Transmission Backbone infrastructure has been a landmark development in Uganda's quest to enhance its telecommunication framework. This infrastructure provides a robust network for high-speed data transmission across the country, connecting various regions and facilitating efficient communication. The backbone network supports the flow of information necessary for AI applications, enabling real-time data exchange and processing capabilities. By connecting urban centres with remote areas, the backbone infrastructure contributes to bridging the digital divide and supports initiatives aimed at promoting AI adoption in diverse sectors, including agriculture, health, and education.

d) Mobile phone penetration in Uganda has rapidly increased to approximately 67.7 per cent (UCC, 2023; GSMA Intelligence 2024), serving as a critical enabler of digital services and applications, including AI solutions. With a significant portion of the population relying on mobile devices for communication, banking, and access to information, the mobile network infrastructure is essential for reaching a broad audience. This high mobile penetration rate supports the deployment of mobile-based AI applications, such as chatbots for customer service, mobile health applications, and data collection tools for research and analysis. Leveraging the existing mobile infrastructure can enhance the delivery of AI-driven services, especially in areas with limited access to traditional Internet connectivity.

Uganda's infrastructure for AI is underpinned by the National Data Centre, widespread Internet connectivity, a robust data transmission backbone, and high mobile penetration rates. Together, these elements create a conducive environment for AI development and deployment, allowing for the integration of advanced technologies that can drive innovation and support sustainable growth across various sectors. Continued investment and strategic enhancements to this infrastructure will be vital for maximizing the potential of AI in Uganda's digital transformation journey.

5.8 Limitations in carrying out the benchmarking study

Conducting a benchmarking study to assess the enabling environment for AI deployment and use was presented with several inherent challenges and limitations. This section outlines the key limitations encountered during the study and the strategies employed to mitigate them.

a) Benchmarking, while valuable, comes with potential challenges and problems. Among the problems identified in this study were variability in data sources which describe an enabling environment providing supportive infrastructure for AI deployment and use in the different countries. To address this issue, the study exclusively utilized studies, articles, and papers from reputable and authentic sources, ensuring that the information gathered

was credible and reliable. This approach minimized the risk of drawing conclusions based on biased or inaccurate data.

b) Lack of comprehensive and up-to-date data: A considerable limitation of the benchmarking process was the lack of comprehensive, current, and publicly accessible data. In certain instances, it was necessary to rely on summaries or brief descriptions of national strategies related to AI and 4IR technologies. Such limitations in data availability can hinder a thorough comparative analysis, as critical details necessary for robust evaluations may be missing. To compensate for these gaps, industry expert insight and knowledge ere gained to enrich the understanding of the policies and initiatives in place. This collaborative approach helped fill the information gap and provided a more nuanced perspective on the AI landscape.

c) Rapid technological advancements: The fast pace of technological evolution, particularly with emerging technologies such as generative AI and quantum computing, poses a limitation. Policies and initiatives established prior to these advancements may not fully account for their implications or operational nuances. Consequently, some strategies may be outdated or inadequately equipped to address the challenges posed by these new technologies. To enhance the relevance of the analysis, the study incorporated projections regarding the behaviour and impact of these technologies within existing policies and initiatives. By evaluating how well current frameworks can adapt to or integrate these advancements, the study aimed to provide a forward-looking assessment that reflects the dynamic nature of the AI landscape.

d) Limited time to undertake the benchmark study. To conduct a comprehensive study which is representative enough to draw conclusions and recommendation, major focus was on key areas where data was easily accessible.

Overall, while these limitations present challenges to the benchmarking process, the methodologies employed aimed to ensure that the findings remain relevant and actionable for policymakers and stakeholders seeking to enhance the infrastructure for AI deployment and utilization.

Uganda can adopt key elements identified through this study to inform the development of effective and sustainable policies, but a contextualized approach is necessary to accommodate local conditions and resources. Addressing these limitations through continued research, collaboration, and adaptive policy formulation will help Uganda lay a solid foundation for its journey into the fourth industrial revolution.

6 Proposed AI risk management framework

The Ministry of ICT and National Guidance is implementing the Digital Transformation Roadmap, which aims to strengthen the implementation of enabling policies and laws to accelerate Uganda's digital revolution. The roadmap will provide an overarching implementation framework for a connected Uganda that delivers on the opportunities presented by technologies that are expected to increase ICT penetration and enhance the use of ICT services for social and economic development. The Digital Transformation Roadmap has been developed as an implementation tool towards achieving the objectives of the Digital Uganda Vision which builds on the Uganda National 4IR Strategy by leveraging AI and other 4IR technologies in building an AI ecosystem. These technologies offer unprecedented potential for innovation, stimulating economic growth, and enhanced quality of life. The development of an AI ecosystem is a complex process involving multiple activities, AI infrastructure, devices, accessories, diverse stakeholders, and associated risks. If these risks and potential negative consequences are not effectively managed, they will jeopardize the success of the programme.

Risks identified during the AI landscape assessment include bias and discrimination, privacy violation, lack of transparency, inequitable access, security vulnerability, job displacement, lack of accountability, compliance, cyber threats, safety and incorrect AI decisions requiring appropriate risk management framework to proactively protect organizations and end users from the distinctive risks of AI. The risk management process involves risk identification, risk assessment, risk response planning, risk monitoring and control, risk evaluation and reporting. This process can be supported by using a framework to mitigate risks associated with AI systems.

A proposed AI RMF has been developed to guide MDAs and private sector organizations to design, develop, deploy and use, AI systems in a responsible and trustworthy manner. It is expected that the MDAs will share an abridged version of the RMF with the different private sectors players under their jurisdictions. The framework incorporates best practices adopted from international and national laws, standards and frameworks.

6.1 AI risk matrix

The public and private institutions in Uganda appreciate AI risks and the potential negative impacts. A summary of AI risks by institution and risk type is set out as a matrix in Table 7.

Table 7: AI risk matrix by institution

| Institutions | Types of risk | | | | | |
	Human rights	Bias	Privacy	Computer security	Safety	Accountability
Ministry of Health	L	L	M	M	H	H
Ministry of Energy and Mineral Development	H	M	H	M	0	L
Kampala Capital City Authority	L	H	H	M	M	L

Table 7: AI risk matrix by institution (continued)

Institutions	Types of risk					
	Human rights	Bias	Privacy	Computer security	Safety	Accountability
Ministry of Works and Transport	H	0	M	0	H	0
Ministry of Lands, Housing, and Urban Development	0	0	0	0	0	0
National Planning Authority	L	L	M	M	M	M
Bank of Uganda	M	M	M	L	L	H
Ministry of Finance, Planning and Economic Development	L	M	L	M	L	L
Ministry of Agriculture, Animal Industry, and Fisheries	L	L	L	L	M	L
Uganda Revenue Authority	L	M	M	L	L	L
Stanbic Bank Uganda	M	H	H	H	L	H
MTN Uganda	L	L	M	L	L	L

0	No response
L	Low risk
M	Medium risk
H	High risk

- In the health sector accountability and safety risk of AI technologies are regarded as having risks and should be avoided. Decisions made by an AI system, especially those concerning diagnosis, treatment plans, or life-critical interventions, must always be verified by a qualified healthcare professional. The AI technology supporting health care services should be designed and developed in such a way that it protects privacy since this encourages an environment of trust and open communication between health professionals and their patients. When patients feel confident that their personal information is secure, they are more likely to share necessary details that may impact their diagnosis and treatment.

- In the energy sector human rights are regarded as high risk because AI decisions could result in social inequalities in the distribution of energy services to the different areas of the country.

- The risk of AI technology in urban planning by institutions such as KCCA is regarded as high for bias. Incorrect AI decisions in urban planning may lead to environmental degradation and unequal access to resources like water, energy, schools and roads.

- In the agriculture sector AI powered technology such as drones, robots and autonomous machines are being used in the management of farms. The risks to humans, animals, and infrastructure in case they malfunction may be grave therefore safety is a concern.

- The financial sector reveals that the use of AI technology may appreciably impact risks such as bias, privacy and accountability. Lack of accountability can incentivize unethical behaviour and fraud which may destroy the trust of customers while lack of privacy may expose sensitive customer data, making them targets for cyberattacks, fraud and data breaches. Bias may affect credit vetting scoring denying customers access to financial borrowing to expand their businesses.

- In the telecommunication sector privacy is important because they collect and store a lot of personal data, including call logs, messages, and location data. This data can be used to identify individuals, track their movements, and monitor their communication activities. AI technology divulging such information to the public may compromise a customer's security. Data privacy is therefore important in the telecommunication sector to protect the confidentiality, integrity, and availability of personal information.

The AI risk mitigation strategy employed by MDAs and private organizations include:

- risk reduction;

- risk acceptance;

- risk transfer;

- risk avoidance.

Risk reduction mechanisms include the use of human oversight over AI systems, deployment of ethical and security standards, robust testing and evaluation of AI systems before deployment. Risk acceptance means you do nothing about it, this is if the risk is too low compared to the benefits from the AI system. Risk transfer could be achieved through insurance or AI system service provider accountability for risk arising from the system supplied. Risk avoidance could lead to abandoning AI deployment if the risk is far greater than the benefits of AI systems.

The mitigation strategy adopts structured processes to identify, evaluate, and proportionately mitigate risks associated with AI systems. These mechanisms may be used by both public and private entities that wish to develop and deploy trustworthy AI systems and are broadly considered a promising tool for AI governance and accountability. Ensuring that AI systems are safe and trustworthy is critical in increasing people's confidence and harnessing the potential socio-economic benefits of this digital technology. Some of the widely used AI risk management approaches to be considered for adoption in the Uganda context are legal, standard and framework based. The next section reviews some of the existing AI risk management frameworks and standards.

6.2   Legal approach to AI risk management

A legal based approach to AI risk management pursues a burden of compliance that is proportionate to the risks of a specific AI application.

European Union Artificial Intelligence Act (EU AI Act)

The EU AI Act is the first comprehensive legal framework on AI worldwide. It aims to ensure that AI systems respect fundamental rights, safety, and ethical principles. The act also aims to support the development of trustworthy AI and strengthen investment and innovation in AI across the EU. The levels of risk are classified into four categories: unacceptable risk, high risk, limited risk, and minimal risk as shown in Figure 19.

Figure 19: EU system for classification of AI impacts

Unacceptable Risk	• Systems that threaten people's safety, livelihood, or rights, such as social scoring and voice-assisted toys, are prohibited.
High Risk	• Systems used in law enforcement or critical infrastructure, such as transportation and healthcare, face strict requirements. • These requirements include risk assessment, data quality, documentation, transparency, human oversight, and accuracy
Limited Risk	• Systems like chatbots must be transparent so users know they are not interacting with humans. They also require some oversight to ensure they don't cause harm.
Minimal Risks	• Systems like spam filters and games can be used freely.

Source: European Union, 2024

The EU AI Act classifies AI systems into four risk categories:

1. Unacceptable risk: Applications that create an unacceptable risk, such as government-run social scoring, are banned.

2. High-risk: Applications that pose a significant risk to people's health, safety, or fundamental rights, such as CV-scanning tools, are subject to specific legal requirements.

3. Limited risk: Applications that pose limited risk because of their lack of transparency are subject to information and transparency requirements.

4. Minimal risk systems are not subject to any regulatory requirements but are encouraged to adopt voluntary codes of conduct.

Unites States Algorithm Accountability Act 2022

The act authorized the Unites States Federal Trade Commission (FTC) to issue regulations mandating specific commercial entities to conduct impact assessments of high-risk automated decision systems (ADS). The assessment required vendors to document the system in detail, assess the relative costs and benefits, determine the risks to the privacy and security of AI systems.

The Algorithmic Accountability Act (AAA) is a proposed law in the United States that aims to make companies more transparent about their algorithms and ensure they are fair and unbiased. The AAA requires companies to:

- Assess the impact of their algorithms: Study and report on the impact of their algorithms on consumers, including how they affect critical decisions like housing, healthcare, and financial services.

- Conduct impact assessments: Evaluate the privacy, accuracy, fairness, and potential biases of their algorithms.

- Submit assessments to the FTC: Submit their assessments and maintain robust security practices to protect customer data.

- Document the development and deployment process of their algorithms.

The AAA is an example of ex-ante regulation, which means it emphasizes proactive risk management and accountability rather than reactive measures. The AAA applies to large companies that meet certain criteria, such as having an annual turnover over USD 50 million or processing the information of over 1 million users. The FTC is responsible for enforcing the AAA, with the help of specified state officials.

Uganda Data Protection and Privacy Law, 2019

An act to protect the privacy of the individual and of personal data by regulating the collection and processing of personal data, providing for the right of persons whose data is collected and the obligation of the data collectors, data processors, to regulate the use or disclosure of personal information.

The law mitigates the risk of data breach, unauthorized access to personal information, identity theft and reputational damage that may occur when sensitive personal data is not adequately protected.

6.3 Standard-based approach to AI risk management

The International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC) and the Institute of Electrical and Electronics Engineers Standards Association (IEEE SA) have initiated the development of standards for AI risk management and governance.

ISO/IEC 23894:2023 – AI Guidance on Risk Management

ISO/IEC 23894:2023 provides guidance on how organizations that develop, produce, deploy or use products, systems and services that utilize AI can manage AI risks. The guidance aims to assist organizations to integrate risk management into their AI-related activities and functions. It describes processes for the effective implementation and integration of AI risk management with the following elements:

- The principles of AI risk management should address the needs of the organizations using an integrated, structured and comprehensive approach. These principles apply to all organization levels whether strategic, tactical or operations.

- The framework describes the general requirements for AI Risk management including leadership commitment, integration, design, implementation, evaluation and improvement.

- The risk management process includes scope, context and criteria; risk assessment; risk treatment, monitoring and review; recording and reporting and communication.

ISO 42001/IEC – Artificial Intelligence Management Systems

This standard provides guidance on AI risk management as prescribed in ISO/IEC 28894 as well as offering a broader framework for managing the entire AI system encompassing not only just risk but also governance, development, deployment and ongoing monitoring of AI systems across the organizations life cycle.

IEEE 7000-2021 series: IEEE AI Standard series

The standard establishes a set of processes by which organizations can include consideration of ethical values throughout the stages of concept exploration and development.

It involves traceability of ethical values through an operational concept, value propositions, and value dispositions. It is comprised of 15 ethical standards for AI system as follows:

- IEEE7000: Model Process for Addressing Ethical Concerns During System Design
- IEEE7001: Transparency process in autonomous systems
- IEEE7002: Data Privacy Process
- IEEE7003: Algorithmic Bias Considerations
- IEEE7004: Standard on Child and Student Data Governance
- IEEE7005: Standard on Employer Data Governance
- IEEE7006: Standard on Personal Data AI Agent Working Group
- IEEE7007: Ontological Standard for Ethically driven Robotics and Automation Systems
- IEEE7008: Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems
- IEEE7009: Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems
- IEEE7010: Wellbeing Metrics Standard for Ethical Artificial Intelligence and Autonomous Systems
- IEEE7011: Standard for the Process of Identifying and Rating the Trustworthiness of News Sources
- IEEE7012: Standard for Machine Readable Personal Privacy Terms
- IEEE7013: Inclusion and Application Standards for Automated Facial Analysis Technology
- IEEE7014: Standard for Ethical considerations in Emulated Empathy in Autonomous and Intelligent Systems

6.4   Framework for AI risk management

The most widely adopted risk management framework was developed by the National Institute of Standards and Technology (NIST).

The framework provides a structured approach to identify, assess, and mitigate risks associated with AI systems while assuring ethical adoption, protecting against potential harm, encouraging accountability, transparency and protecting individual rights when implementing AI systems. It consists of two parts: the foundation (part 1) and core (part 2) as shown in Figure 20.

Figure 20: NIST AI risk management framework
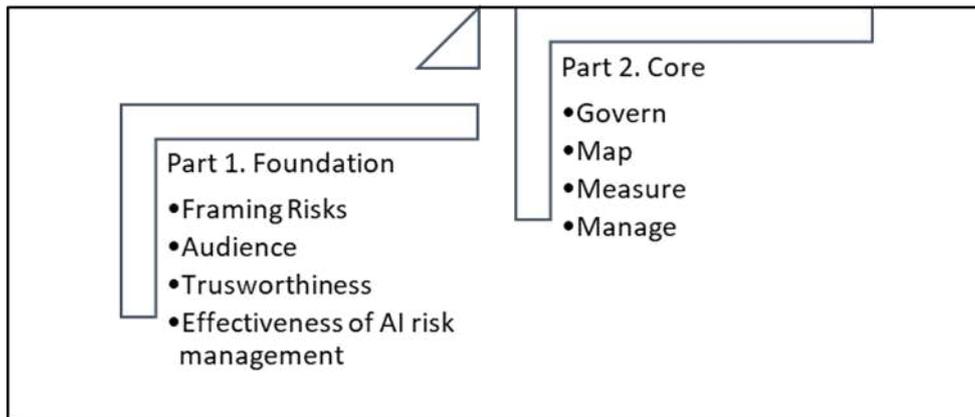
Source: (NIST, 2023)

6.4.1   Part 1: Foundation

The foundation addresses the kind of risks and harms that may arise due to the use of AI systems. The harm can be categorized as those to people, organization and the ecosystem. It is further subdivided into framing risks, audience, trustworthiness and organization integration and managing AI risk. It is further subdivided into framing risk, audience, trustworthiness, organization integration and managing risk.

a)   Framing risk

Framing risk in the context of the AI risk management framework (NIST AI RMF) refers to the process of defining and understanding the potential negative impacts or risks associated with an AI system by considering various factors like societal, ethical, legal, and technical implications, to effectively manage and mitigate those risks throughout the AI lifecycle.

Impact or harm can be experienced by individuals, groups, communities, organizations, society, the environment, and the planet at various levels as shown in Figure 21.

Figure 21: Examples of potential harm related to AI systems

Low Impact	•individual harm of rights, phyisical harm, •physcological safety, loss of economic opportunity
Moderate Impact	•Harm to organisation operations, Harm to organisation in terms of security breaches and monetary loss •Harm to group of people •Harm to organisation reputation
High Imoact	•Harm Society orcommunity , eg wider contanimantion of water, discrimination of a community, Society Harm to democratisation or Education or health or denial of service
Unacceptabl eImpact	•Harm to interconnected or interdependent element •Harm to global financial system , supply chain •Harm to natural resources, environment and the planet

Source: (NIST, 2023)

Trustworthy AI systems and their responsible use can mitigate undesired impacts and contribute to benefits for people, organizations, and ecosystems.AI risks or impacts that are not well-defined or adequately understood are difficult to measure quantitatively or qualitatively. Risk tolerance and prioritization levels therefore should be well defined.

Risk tolerance refers to the organizations or actor's readiness to bear the risk of achieving its objectives. Risk tolerance and the level of risk that is acceptable to organizations or society are highly contextual and application is use-case specific. Risk tolerances can be influenced by policies and norms established by AI system owners, organizations, industries, communities, or policy-makers. Risk tolerances are likely to change over time as AI systems, policies, and norms evolve. Different organizations may have varied risk tolerances due to their organizational priorities and resource considerations.

Risk prioritization is necessary as it affects deployment of AI systems. Organizations must define risk impact levels, such as where significant negative impacts are imminent or catastrophic risks are present. The development and deployment of AI systems should be stopped until unacceptable AI risks are sufficiently managed. In addition, any residual impact must be documented so that the AI system provider can inform end-users about the potential negative impacts of interacting with an AI system.

b) Audiences (AI Actors)

The audiences in part 1 of AI RMF 1.0 are from diverse experience, expertise, and backgrounds involved or impacted by the AI life cycle are as shown in Figure 22.

Figure 22: AI audiences across the AI system development cycle
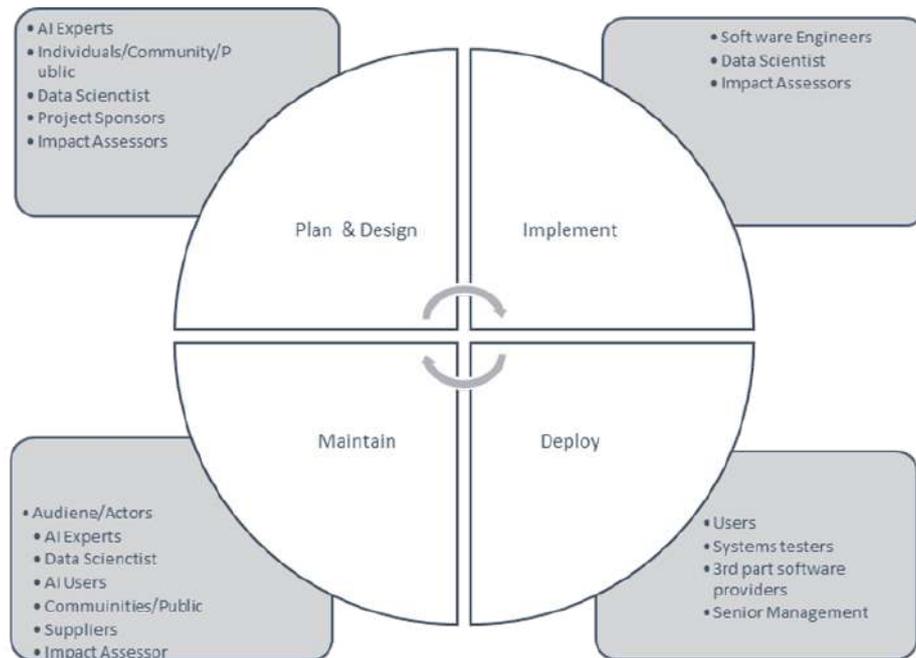
Source: (NIST, 2023)

Table 8 describes the purpose, activities, risks and impacts likely to manifest in the different phases of the AI system development life cycle.

Table 8: System development cycle, risks and impacts

AI life cycle	AI purpose and activities	Risks	Impacts
Plan and design	Purpose: Establish theoretical foundations of an AI system Activities: – Document system concepts and objectives – Establish the legal and regulatory requirements – Document meta data and data sets considering system objective	– Lack of mission transparency – Human rights / Ethics violation – Digital divide – Financial burden – Data sources inadequacy – Infrastructure inadequacy	– Harm to individual, organization, community or public – Financial impact – Legal sanctions/ court actions – Disruption of services or operations

Table 8: System development cycle, risks and impacts (continued)

AI life cycle	AI purpose and activities	Risks	Impacts
Imple-ment	Purpose: Build the AI algorithm Activities: – Create or select algorithm – Gather validate and clean data	– Manipulation and abuse through AI – Skills shortage – Data quality risk Sensitive or proxy information – Privacy violation in data collection – Algorithm lack of transparency or interpretability – Algorithm unreliability – Regulatory breach	– Harm to individual, group, community or public – Harm to environment – Financial Loss – Legal sanctions or – Disruption of service – Quality of service
Deploy	Purpose: Releasing the AI systems to a life environment Activities: – System integration – Piloting systems – Check compatibility with legacy systems – Verifying regulatory requirements – Managing organization change	– Unaudited algorithm – Rejection by AI audience – Insufficient system security – Insecure data and algorithm storage	– Harm to people, society – Harm to environment – Breach of rights – Disruption of service
Maintain	Purpose: Monitor the system, environment Activities: – Operate AI system – Monitor compliance with system performance objectives legal and regulatory objects and social and society objective	– Inadequate user feedback – Outdated data, algorithm – System expires	– Harm to people, environment and community – Breach of human rights – Disruption of service

c)   AI risk and trustworthiness

AI systems must be responsive to various essential factors for interested parties to trust it. Approaches which enhance AI trustworthiness can reduce negative AI risks. As in NIST 2023, the characteristics of trustworthy AI systems include valid and reliable, safe, secure and resilient, accountable and transparent, explainable and interpretable, privacy-enhanced, and fair with harmful bias managed.

d)   Effectiveness of AI risk management framework

Evaluating the effectiveness of an AI risk management framework (AI RMF) is critical to ensuring that the framework achieves its goals of mitigating risks, fostering trust, and enhancing the safe, responsible deployment of AI technologies.

6.4.2   Part 2: Core

The core has four distinct functions to address risks and impacts in an AI system. These four functions are govern, map, measure, and manage as shown in Figure 23.

Figure 23: NIST risk management framework

Source: (NIST, 2023)

The purpose of the govern function of the AI risk management framework core is to ensure that:

a) The policies, processes, procedures, and practices across the organization related to the mapping, measuring, and managing of AI risks are in place, transparent, and implemented effectively.

b) Accountability structures are in place so that the appropriate teams and individuals are empowered, responsible, and trained for mapping, measuring, and managing AI risks.

c) Workforce diversity, equity, inclusion, and accessibility processes are prioritized in the mapping, measuring, and managing of AI risks throughout the lifecycle.

d) Organizational teams are committed to a culture that considers and communicates AI risk management practices.

e) Processes are in place for robust engagement with relevant AI actors.

f) Policies and procedures are in place to address AI risks and benefits arising from third-party software and data and other supply chain issues.

The purpose of the map functions of the AI risk management frameworkis to ensure that:

a) Context is established and understood: This action ensures that the purpose, objectives, benefits, actors, missions, business value, risk tolerance of the AI system are determined and documented.

b) Categorization of the AI system is performed to ensure that the specific task performed by the AI system is well monitored.

c) AI capabilities, targeted usage, goals, and expected benefits and costs compared with appropriate benchmarks are understood.

d)   Risks and benefits are mapped for all components of the AI system, including third-party software and data.

e)   Impacts to individuals, groups, communities, organizations, and society are characterized.

The measure function of the AI risk management framework leverages quantitative, qualitative, or mixed-method tools, techniques, and methodologies to analyse, assess, benchmark, and monitor AI risk and associated impacts. It uses information relevant to AI risks found in the map function and provides guidance to the manage function.

The purpose of the measure function is to ensure that:

a)   Appropriate methods and metrics are identified and applied on the risks, trustworthiness characteristics, controls by an internal expert and not the system implementers. Including system performance test, evaluation, validation, and verification.

b)   AI systems are evaluated for trustworthy characteristics.

c)   Mechanisms for tracking identified AI risks over time are in place.

d)   Feedback about the efficacy of measurement is gathered and assessed.

The manage function of the AI RMF leverages the information obtained from the govern, map, and measure phase of the AI risk assessments to apply risk treatment plans and respond to, recovering from and communicating about AI events and risk incidents.

The manage function ensures that:

a)   AI risks that have been assessed are prioritized, responded to, and managed.

b)   Strategies to maximize AI benefits and minimize negative impacts are planned, prepared, implemented, documented, and informed by input from relevant AI actors.

c)   AI risks and benefits from third-party entities are managed.

d)   Risk treatments, including response and recovery, and communication plans for the identified and measured AI risks are documented and monitored regularly.

6.5   Features of an effective AI risk management framework

The desirable features for adoption in the proposed AI RMF effective AI risk management framework are establishing context for AI risk management, establishing context for AI risk governance arrangements, AI impact assessment, AI risk assessment, AI risk management and AI risk recording, monitoring and reporting.

Context establishment

Establishing the context for AI risk management involves:

a)   Identifying existing and potential AI systems and applications that support the achievement of the organization strategic goals and objectives.

b)   Outlining the principles of AI trustworthiness that AI systems should have to establish the trust of stakeholders within the organization.

c)   Identifying the potential harm and risk of AI to the organization, community, group of people or environment.

d)   Identifying individuals impacted by the AI including staff, organization services, customers, public, senior management, board.

e)   Identifying sources of AI risks in the entire AI system life cycles including the AI actors, data sources, input, storage and output, AI algorithm and ICT infrastructure for the AI system.

The laws, standards and frameworks applicable to this feature are from EU AI Act, ISO/IEC 23593:2023, ISO/IEC 42001 and NIST AI risk management framework.

AI risk governance

An AI risk management framework is a cross-cutting function incorporated throughout AI risk management cycles and enables other functions of the AI risk management process. These features include:

a) Putting in place AI policies, laws, regulations and procedures relating to management of AI risks identified.

b) Establishing the organization structure of personnel responsible for the management of AI risks.

c) Defining roles, responsibilities and accountabilities for the by all actors in the AI ecosystems.

d) Defining policies and procedures to address AI risk related to third party service providers.

The laws, standards and frameworks applicable to this feature are from ISO/IEC 38507:2022, ISO/IEC 42001 and NISTAI RMF.

AI impact assessment

This feature is for assessing the impact of AI risk to individuals, groups, communities, organizations and it is used to classify AI risk and to determine the appropriate risk management strategy.

AI risk assessment

AI risk assessment feature is for:

a) The identification of metrics/measure including quantitative, qualitative, or mixed-method tools, techniques, and methodologies for analysis, assessment, benchmarking, and monitoring AI risk and impacts.

b) Measuring, assessing and analysing AI risks including metrics for trustworthy characteristics, social impact, and human-AI configurations.

c) Monitoring AI risks over time.

d) Providing feedback about efficacy of measurement gathered.

e) AI risk management.

The laws, standards and frameworks applicable to this feature are from ISO/IEC 38507:2022, ISO/IEC 42001 and NIST AI RMF.

AI risk management

Ai risk management involve:

a) Establishing residual risks (defined as the sum of all unmitigated risks) to both downstream acquirers of AI systems and end users.

b) Implementing strategies required to manage AI residual risks along with viable non-AI alternative approaches, or methods – to reduce the magnitude or likelihood of potential impacts.

c) Risk treatments, including response and recovery, and communication plans for the identified and measured AI risks are documented and monitored regularly.

The laws, standards and frameworks applicable to this feature are from EU AI Act, ISO /IEC 23593:2023, ISO/IEC 42001 and NIST AI RMF.

Risk recording and reporting

The process of documenting identified AI risks within an organization along with details about their potential impacts and mitigation strategies and communicating this information to relevant stakeholders through regular reports. The standards and frameworks applicable to this feature are from ISO/IEC 23593:2023, ISO/IEC 42001 and NIST AI RMF.

6.6   Six main components AI risk management framework

The proposed RMF will be considered as a structured blueprint guiding MDAs and private organizations under their jurisdiction in the intricate process of AI risk management.

The benefits of the AI RMF include the following:

a)   Enables MDAs to maximize the benefits of AI implementation while minimizing its negative impacts.

b)   Protect the public and users of AI from potential harm of AI.

c)   Ensure ethical and responsible AI development.

d)   Build trust in AI systems among users and stakeholders.

e)   Comply with emerging regulations and standards for AI.

f)   Implement a robust AI RMF in MDAs and private sector players to harness the opportunities AI presents, while safeguarding against its potential negative consequences.

The proposed AI RMF is developed to guide MDAs and private organizations design, develop, use, and evaluate AI systems in a responsible and trustworthy manner. It is expected that the MDAs will share an abridged version of the RMF with the different private sectors players under their jurisdictions. The framework incorporates best practices from laws, standards and framework reviewed. The proposed AI RMF is organized into six main components as shown in Figure 24.

Figure 24: Proposed risk management framework
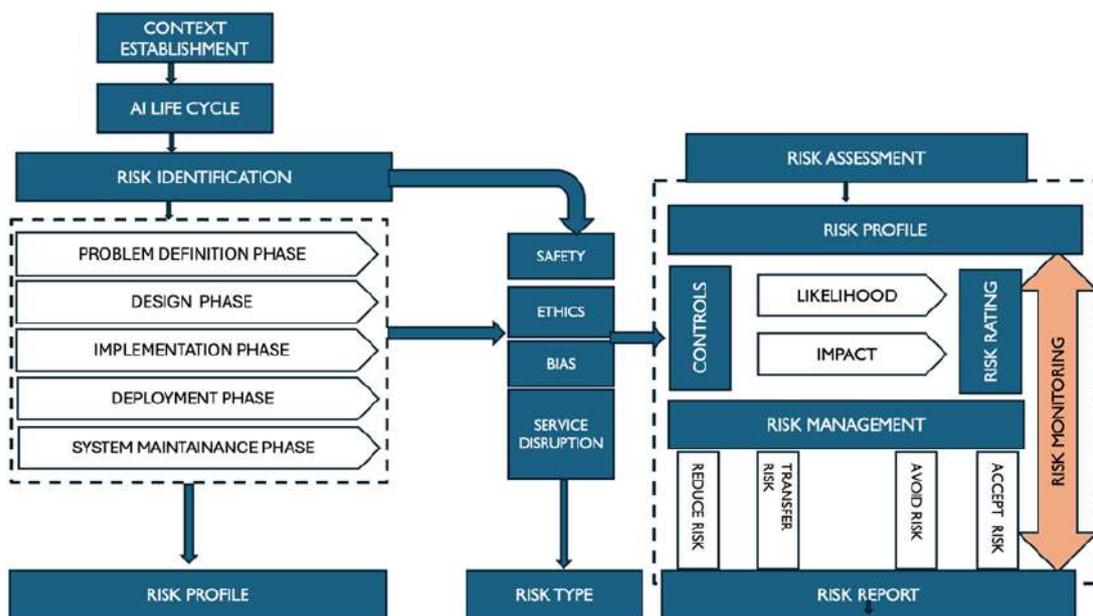
Source: Project research, 2024.

6.6.1   AI risk context

The AI risk context function will establish the purpose, stakeholders impacted, sources of risk in the AI and key principles of trustworthiness to be achieved by the AI system.

a)   Purpose of the proposed AI risk management framework:

The purpose of the proposed AI RMF are as follows:

  –   Promote AI governance and innovation in Uganda while managing risks associated with its use for national development.

  –   Provide a structured guideline for identifying, assessing, and mitigating the diverse risks associated with AI systems.

  –   Support MDAs and the private sector to take a systematic approach to addressing AI challenges, while harnessing the opportunities it presents.

b)   Guiding principles:

  –   AI must be valid and reliable: The AI system should function as planned and consistently generating accurate findings, which is crucial in determining the validity of AI outputs for use in decision-making processes.

  –   Security and resiliency: The AI must guard against malicious attacks, misuse, and unauthorized access. Trusted AI systems should be built with strong security features. In addition, they must be resilient in order to operate during and after any disruptive incidents.

  –   Privacy protection: AI system should protect sensitive data and ensure its use conforms with applicable rules and laws of data protection and privacy.

  –   Transparency and accountability: AI should be evident on who bears responsibility for the acts of the system with an unobstructed view of the system's workings. AI decisions should be visible to humans and not concealed behind a "black box".

  –   Interpretability and explicability: The AI system must offer concise and intelligible justifications for any decisions or actions to maintain user confidence and system accountability.

  –   Fairness, with zero negative bias: Unfair biases or discrimination should not be incorporated into the design of the AI system. This entails a concerted effort to locate and eliminate any detrimental biases in the system architecture or results.

c)   Scope:

  –   Sector scope: The AI RMF covers the Ministry of ICT and National Guidance, Ministry of Agriculture, Ministry of Health, Ministry of Finance, Planning and Economic Development, Ministry of Energy and Mineral Development, Ministry of Works and Transport, Kampala Capital City Authority, Ministry of Lands, Housing and Urban Development, National Planning authority, Bank of Uganda and Uganda Revenue Authority.

  –   Stakeholders/actors scope: The AI RMF covers the accounting officers, AI experts, data scientist, software engineers, system integrators, AI operators, AI users, AI communities, and civil society organizations impacted by the AI applications of the respective MDAs.

  –   AI system development life cycle: The AI RMF covers the AI System development life cycle.

  –   AI application scope: The AI RMF covers AI data input, AI data output, AI model, AI Infrastructure and AI tasks.

6.6.2 AI governance

The AI governance function will support the management of AI risks, including leadership commitment, assigning roles, responsibilities, accountabilities for AI risk management, and risk reporting for all stakeholders.

a)   Leadership commitment:

The Government of Uganda will through the AI National Task Force be committed to this AI RMF for the successful implementation of new and upcoming AI innovations. As such the the Ministry of ICT and National Guidance shall work with other MDAs to ensure that this proposed AI RMF achieves the following:

–   Integrated: It is an integral part of all ministry AI activities.

–   Structured and comprehensive: Ensure that a structured and comprehensive approach to AI risk management that contributes to consistent and comparable results is in place.

–   Customized: Ensure that this AI RMF is customized and proportionate to the MDAs external and internal context related to its AI objectives.

–   Inclusive: Appropriate and timely involvement of stakeholders, incorporating their knowledge, views and perceptions. This results in improved awareness and informed AI risk management procedure.

–   Dynamic: The nature of AI systems is dynamic, due to continuous learning, refining, evaluating, and validating. Additionally, some AI systems could adapt and optimize based on this loop, creating dynamic changes on their own. Risk management anticipates, detects, acknowledges and responds to those changes and events in an appropriate and timely manner.

–   Information availability: Input into AI risk management is based on historical information and current information. Information on AI risk management should be timely, clear and available to relevant stakeholders.

b)   Roles, responsibilities, and accountability:

Leadership for AI risk management follows the top-down approach under the guidance of the AI National Task Force. A committee should be set up by the government to harness the national AI innovations in all sectors. The proposed organogram is shown in Figure 25.

Figure 25: Proposed AI RMF organization structure
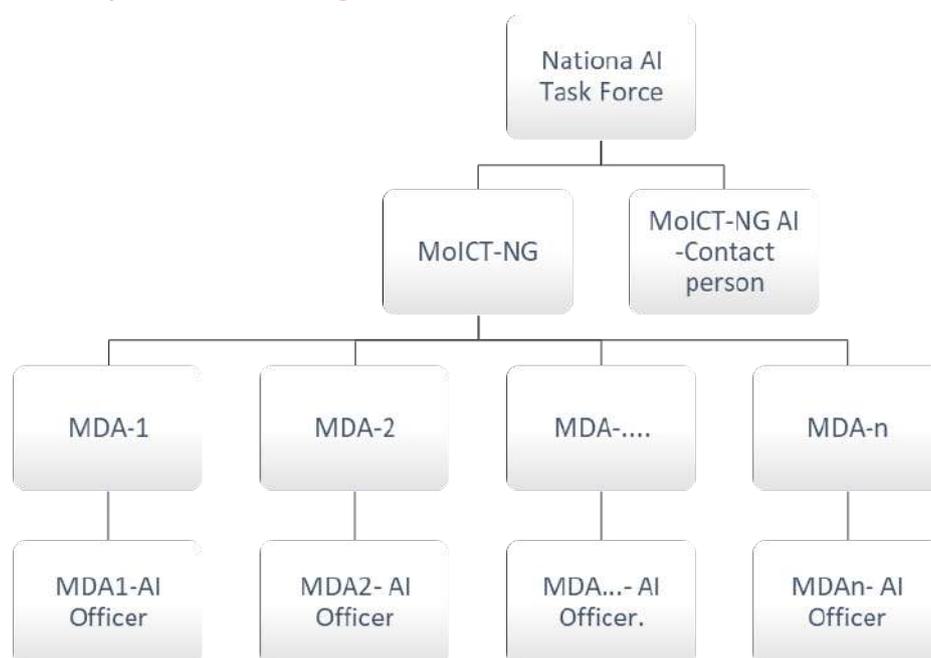
Source: Project research, 2024.

The description of the proposed organization structure to support coordination and reporting for AI risk management is as follows.

- The AI National Task Force is the highest governing body that shall receive reports from different MDAs regarding the effectiveness of the implementation of this RMF.

- MDAs accounting officers shall appoint an AI -Officer responsible for coordination and reporting of AI RMF internally and with/to the Ministry of ICT and National Guidance.

- MDAs may have other actors or stakeholders such as data scientist, software engineers and AI developers whose details though not appearing in the structure may need to be included in the RMF report to the AI National Task Force.

The detailed description of the AI National Task Force, accounting officers and AI officers are as indicated in appendix II, III and IV.

a) Regulatory consideration:

Proposed regulatory areas for consideration are:

- Commitment to data quality and data protection and privacy law.

- Propose a regulation for algorithm quality assurance check on issues such as transparency, robustness, safety and bias.

- Propose a regulation that governs human involvement and accountability for high-risk AI decisions, tasks and outputs.

- Propose policy guidelines for AI incident management plans.

- Propose development of AI procurement guideline to be adopted by MDAs.

b) Capacity building:

Capacity building is a significant element of any successful AI strategy. It is the process of developing and strengthening the skills, instincts, abilities, processes and resources of the MDAs staff and communities impacted by AI to enable them plan, design and deploy AI applications. The capacity building should enlighten the opportunities, challenges and

risks of AI. It may include investing in and providing opportunities for AI-related knowledge and skills development and attracting talent. It is essential that Government of Uganda create the condition to build local AI capacity.

In delivering the capacity building programmes, it is important to recognize the diversity of audiences that need such skills. Diversity can be accommodated through a variety of educational strategies, considering, for example, different generations and levels of digital literacy. Invest in interdisciplinary skills development since there will be need for people with skills to develop, design and deploy AI systems in addition to training on AI regulation and laws.

c) Awareness:

The public, employees and customers need to be made aware of the common uses of AI as a first step towards broader public engagement with debates about the appropriate role and boundaries for AI. This is to avoid scepticism from users about the potential negative consequences it can have.

6.6.3   AI risk identification

This is the process of identifying risk events that could impact people and capacity to deliver services without loss of trustworthiness on the AI solutions. AI risk identification happens throughout the AI systems development life cycle phases as shown in Figure 26.

Figure 26: Risk identification during AI system development life cycle
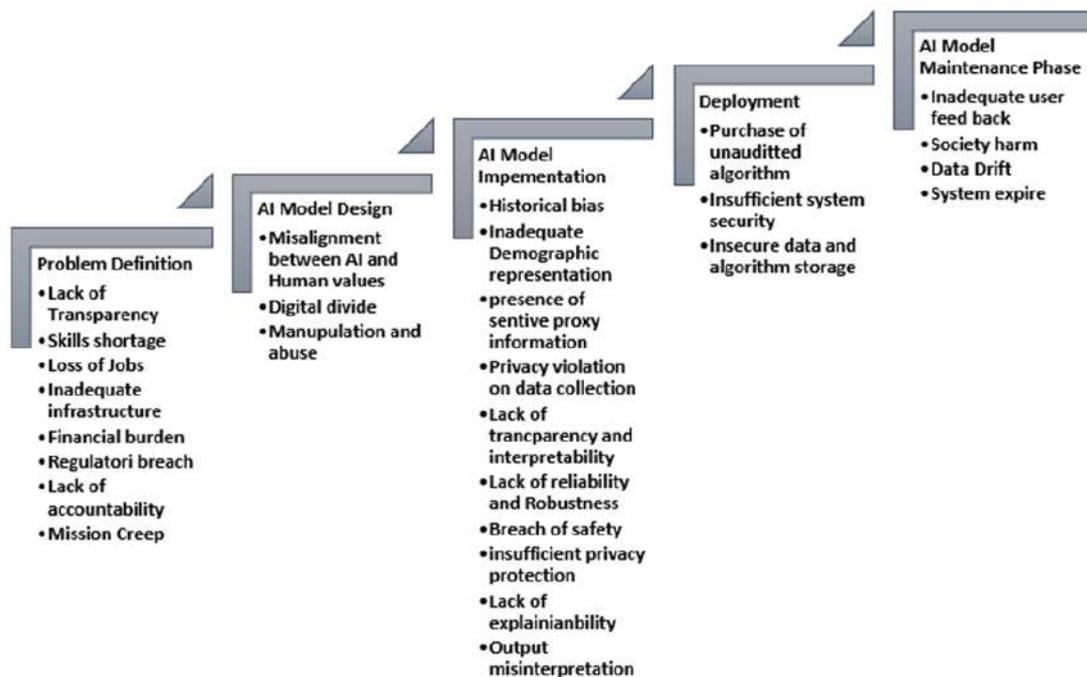
Source: (NIST, 2023)

The risks highlighted in Fig 26 are for illustration only as unforeseen risks may arise.

6.6.4   AI risk assessment

This is a systematic process where identified AI risks are analysed and evaluated (assessed) by determining the likelihood and potential impact of harm occurring.

a)   Likelihood assessment: Likelihood refers to the probability of an event occurring. In this risk assessment, likelihood is defined on a scale of 1 to 5, as described in Table 9.

Table 9: Likelihood of an event occurring

	Likelihood	Description
5	Very likely	The event is almost certain to occur. It is expected to happen most of the time.
4	Likely	The event is expected to occur frequently or in the normal course of operations. It may not happen every time, but there is a substantial probability that it will occur.
3	Possible	There is a fair chance the event will occur. It may happen occasionally, and may be triggered by certain conditions, but it is not something that is expected to happen consistently or frequently.
2	Unlikely:	The event is not expected to occur frequently or in the normal course of operations. This level generally corresponds to occurrences that are unusual or uncommon.
1	Very unlikely:	There is a very low chance that the event will occur. It would only happen under exceptional circumstances or in rare cases.

b)   AI impact assessment: The purpose of AI impact assessment is to establish the severity of the negative effect of AI system on the people, trustworthiness and service delivery and establish applicable legal, regulatory and policies guidelines to manage the AI risks.

Table 10 describes the impact rating criteria on a scale of 1 to 5 (ISO 31000:2018).

Table 10: Impact rating criteria

	Severity	Harm to people	Trustworthiness	Service delivery
5	Cata-strophic	Group or community affected. with death reported.	Matter in court with little chance to win case Extensive media overage about AI system malfunction.	Total loss, delay or disruption for more than 1 week of critical services • Non-delivery of strategic objective. • Above 10% critical staff turnover. • Above 15% of votes impacted • Strongly involves the Permanent Secretary and other legal arms of the government • System completely shut down

Table 10: Impact rating criteria (continued)

	Severity	Harm to people	Trustworthiness	Service delivery
4	Severe	More than 10 people affected Could lead to some death or regulatory sanction by authority.	Lasting impact effect. Matter requires investigation. Could lead to legal consequence.	Total loss, delay or disruption for 2 to 7 days of IPPS • 4% to 10% critical staff turnover. • 10% to 15% of votes impacted. • Detailed action plan required. • Significantly involves Senior Officials.
3	Moderate	Moderate harm to public or group of people. More than 5 people admitted in hospital or under intensive care.	No public is aware of the unreliability of the system, but all internal staff are aware of the unreliability of the AI system.	Serious delay or disruption of critical services • Critical staff turnover • May draw attention of the Permanent Secretary.
2	Limited	Limited harm to individual or group of people. less than 1 person affected or slight damage to environment.	Internal stakeholder aware of the system unreliability or inaccuracy and issues are being resolved	• Minor delay or disruption of critical services • Specified ownership needed • Supervisor involvement.
1	Insignificant	Insignificant harm to individuals or environment	Minimal loss of trust, only few individuals have known about the biases, inaccuracy of the system	Minimal disruption of service delivers less than people

The criteria are only a guide but may vary from organization to organization depending on the AI service being rendered.

c)   Level of AI risk: The risk level is determined as a combination of the likelihood of risk events occurring and the impact of such an event, if it occurs. The level of risk is assessed using the Heatmap in Figure 17.

Figure 27: Risk Matrix/Heatmap

Source: Adapted from ISO23894:2023

Table 11 describes the various levels of risks.

Table 11: Descriptions of risk levels

Level	Score range	Description
Low risk	1 to 4	The likelihood of the event occurring is very low and/or, if it does occur, the impact on individuals and communities will be minimal. This may include AI systems that produce minor inaccuracies or when its use leads to temporary disruption of non-critical services. Despite being classified as low, these risks should still be managed and prevented or mitigated where possible
Moderate risk	5 to 9	The likelihood of the event occurring is low, or, if it does occur the impact will not be severe. This could involve cases such as unintentional bias in non-critical decision-making processes that do not lead to significant harm. These risks require more active management and planning to mitigate.
High risk	9 to 16	The event is likely to occur, or the impact if it does occur will be severe. This could include cases such as significant biases in critical decision-making processes or privacy violations that lead to serious harm. These risks require immediate attention and robust mitigation strategies.
Unacceptable risk	17 to 25	The risk is almost certain to occur, or the impact if it does occur will be extremely severe or catastrophic. This could involve cases such as widespread violations of human rights or other serious harm to individuals. These risks require urgent, comprehensive action, including redesigning or discontinuing the AI system

6.6.5   AI risk management

The four strategies available for managing risks in the AI environment are:

a)   Reduce the risks by choosing an appropriate risk mitigation measure

b)   Accept the risks

c)   Transfer the risks

d)   Avoid the risk

Risk reduction: Risk reduction is about taking actions to reduce likelihood and severity of a risk. Actions to reduce risks could be one of the following:

- Human oversight: Include human oversight to prevent biased or erroneous outcomes.

- Ethical considerations: Establish ethical frameworks and standards for the development, deployment, and use of AI.

- Implement IT security measures for data protection and algorithm protection.

- Data quality and assurance measure.

- Robust testing and validation before deployment.

Accept risk: Accepting risks means you do nothing about it, this is if the risk is too low compared to the benefits from the AI system.

Transferring risk: Risk transfers could be through an insurance company or asking the service provider of the AI system to take accountability for risk arising from the system supplied.

Risk avoidance: Risk could be avoided by abandoning the idea of AI development if the risk far greater than the benefits for the AI systems.

6.6.6   Risk monitoring

Regular audits of AI systems should be carried out to monitor AI systems for adverse impact against key risk areas.

6.6.7   Risk reporting

Reports on AI risk management should be provided at least twice a year for the purpose of obtaining support from the AI National Task Force. The report should cover.

a)   It to avoid future recurrence. Insights into high AI risks across operational Ministry.

b)   Identify emerging risks, assess their impact, and recommend proactive risk mitigation strategies.

c)   List of AI incidents that have occurred and what the MDA is doing.

7   Recommendations

To address the challenges identified during the assessment and foster a thriving AI ecosystem in Uganda, several strategic interventions are proposed. These recommendations aim to build capacity, advance research and development, strengthen data management systems, enhance infrastructure, establish robust regulatory frameworks, and foster collaboration among stakeholders. By addressing these areas highlighted in Table 12, Uganda can create a supportive environment for AI adoption and innovation, benefiting both the public and private sectors.

Table 12: Table of recommendations

Recommendation	Description	Priority
Enhance awareness and understanding of AI	Launch a nationwide AI awareness campaign to educate stakeholders about the opportunities and risks associated with AI technologies. These campaigns should highlight how AI can improve efficiency, drive innovation, and address some of Uganda's most pressing challenges. By using a mix of communication channels, such as radio, television, social media, webinars, and podcasts will ensure the message reaches both urban and rural communities. Engaging influencers and industry experts to simplify AI concepts will be essential, while real-life success stories from Uganda and other countries can demonstrate practical applications and inspire wider adoption._Organize free or subsidized workshops in major cities and rural areas. These workshops should focus on demonstrating how AI can be applied in everyday life, including agriculture, small businesses, and public services. For example, farmers can learn about AI-driven weather predictions or pest control, while small business owners can explore AI tools for inventory management or customer engagement. Such initiatives will not only build public confidence in AI but also promote grassroots innovation.	High
Develop AI skilling and capacity building programmes	Develop AI skilling programmes, recognizing that training and knowledge acquisition are continuous processes. As AI is an evolving technology, ongoing learning and skill development are essential._Offer specialized, tailored training in AI technologies such as data science, machine learning, deep learning, and data analytics to policymakers and government officials. This will help them grasp the broader implications of AI on governance, regulation, data-driven decision-making, and service delivery. By empowering policymakers, Uganda can create a supportive regulatory environment that fosters AI innovation while protecting public interests._Incorporate AI-focused education and skills development into the national curriculum. Embed AI, machine learning, and data science courses in university programmes and consider certifications for local AI experts._Promote AI literacy by establishing community outreach programmes and initiatives that raise awareness of AI's benefits and challenges, ensuring a broader understanding among the population.	High

Table 12: Table of recommendations (continued)

Recommendation	Description	Priority
Develop robust data management systems	Digitize and digitalize all services and processes to enhance data quality for decision-making, improve efficiency, improve customer service, increase accessibility, and strengthen data security. Create a centralized data repository to ensure secure, accessible, and well-governed data for AI initiatives. A uniform identifier, such as national identification number or tax identification number, should be implemented across all organizations to support efficient service delivery to citizens. This repository must incorporate strong security measures to safeguard data integrity and confidentiality, while ensuring convenient access for authorized users. Enforce the use of standardized data, such as information on administrative divisions (districts, counties, sub-counties, parishes, and villages), wherever available. Users should select units from dropdown menus instead of typing (free text) them manually, which can reduce errors. Automating tasks and streamlining processes will increase productivity and reduce costs, as manual data entry often leads to incorrect data during ingestion. All government services should adopt the approved automated administrative divisions for consistent reporting, minimizing ambiguity. Standardized data formats and interoperability protocols are essential to enable seamless integration and analysis across systems. Promote open data initiatives to stimulate innovation. Government agencies and private organizations should make non-sensitive datasets publicly available to the research community, accelerating AI development. These initiatives can spark creativity, improve research quality, and reduce barriers to entry for emerging AI developers.	Medium

Table 12: Table of recommendations (continued)

Recommendation	Description	Priority
Enhance AI infra-structure and connectivity	Invest in hardware and computational resources capable of handling the complex data processing, model design, devel-opment, training, testing, and deployment required for AI. To support this, the government should invest in high-per-formance computing (HPC) infrastructure, a scalable solution that can accommodate growing AI workloads. Addition-ally, the government should consider establishing a public HPC centre to provide affordable computing resources for researchers, startups, and small businesses, reducing reli-ance on external services and making AI development more accessible.	Medium
	Expand the capacity of the existing national data centres to handle high-performance workloads, ensuring Uganda can efficiently support large datasets and AI-driven services. Explore partnerships with global cloud service providers such as AWS, Microsoft Azure, and Google Cloud to access scalable and cost-effective computing power.	
	Improve Internet connectivity to support AI deployment, as reliable access and sufficient bandwidth are crucial for the success of AI applications, cloud services, remote data access, and real-time processing. Strengthening connectivity will ensure that AI services reach all citizens, including those in rural areas. Expand nationwide broadband access through partnerships with telecom companies to ensure high-speed Internet availability, particularly in underserved regions. This is essential for rural communities to access AI-driven services in sectors like healthcare, agriculture, and education. Promote the rollout of 5G technology, which offers faster speeds, lower latency, greater capacity for remote execution, and supports more connected devices compared to 4G.	
	Promote the adoption of advanced technologies like Spatial Data Infrastructure (SDI) which provide data for AI solutions in MDAs such as the Ministry of Lands, which uses it to digi-tize the entire spatial framework for improved planning. SDI is a framework that connects spatial data, metadata, users, and tools in an interactive and flexible way, enabling efficient use of spatial data. This technology fosters geo-information sharing, a critical resource for tackling challenges such as land management issues, urban planning, disease and envi-ronmental degradation monitoring.	

Table 12: Table of recommendations (continued)

Recommendation	Description	Priority
Strengthen policy, legal, and regulatory frameworks	Create a national AI policy and regulatory framework that provides clear guidelines for AI research, deployment, and ethical considerations. This policy should address critical areas such as data privacy, security, and the responsible use of AI in key sectors like healthcare and education. It should also define protocols for data collection, storage, and usage for AI applications while strengthening the enforcement of existing data protection and privacy laws.	High
	Establish a policy to integrate AI in government operation (interventions) to leverage efficiency. AI can significantly streamline bureaucracy at all levels of government. For example, it can help automate routine administrative tasks, such as data entry, document processing, and information retrieval.	
	Develop ethical guidelines for AI development and deployment, emphasizing principles such as transparency, fairness, accountability, safety, and inclusiveness to address issues like bias and discrimination. Engage local communities, civil society, and other stakeholders during the development process to ensure AI solutions are inclusive and meet the needs of all citizens, particularly marginalized groups. Implement policies promoting the use of diverse datasets and regular audits of AI models to minimize bias and ensure fair, equitable outcomes for everyone.	
	Establish regulatory sandboxes to offer startups and innovators-controlled environments for testing AI solutions. This approach enables safe experimentation, fostering innovation while mitigating risks and maintaining public safety and trust.	
	Encourage deployment of relevant AI technologies within MDAs to streamline repetitive tasks, reduce errors, and alleviate the workload on human resources. By improving efficiency, these technologies enable government employees to dedicate more time to complex and strategic responsibilities.	

Table 12: Table of recommendations (continued)

Recommendation	Description	Priority
Promote industry-academia collaboration	Promote collaboration between industry and academia to align research and education with market demands. Partnerships between universities and private companies can drive joint research projects that address industry-specific and local challenges through AI. Co-funded initiatives, knowledge-sharing platforms, and collaborative innovation hubs can further enhance these connections, promoting practical solutions and shared growth. Encourage and support internship and exchange programmes since they are vital for providing students with hands-on experience in AI applications. Embedding students in technology companies and startups exposes them to real-world challenges and enhances their practical skills. Establish industry advisory boards comprising representatives from leading technology companies, academic institutions, government bodies, and startups. This can ensure that AI curricula and research agendas remain relevant and forward-looking. This alignment will help bridge the gap between theoretical knowledge and practical applications, ensuring a steady pipeline of skilled AI professionals.	High
Foster research and development	Prioritize investment in research and development (R&D) as a vital strategy to address local challenges and nurture home-grown AI solutions. Locally developed AI applications are better suited to Uganda's unique community needs, incorporating cultural and societal norms to ensure they are both effective and user-friendly. For instance, localized AI can address specific healthcare challenges, optimize regional agricultural practices, and develop tailored solutions for climate change management. This approach not only delivers practical outcomes but also drives growth in the technology ecosystem, creates jobs for AI professionals, and establishes a sustainable base for future innovation. Promote public-private partnerships (PPPs) as an effective mechanism for mobilizing resources and expertise to advance AI research and development. By sharing risks and leveraging the strengths of both sectors, PPPs can enhance efficiency, productivity, and service quality. The government can incentivize private-sector investment by offering tax benefits and co-funding opportunities, mitigating the risks often associated with AI research and fostering greater collaboration. Regularly organize initiatives like hackathons, innovation challenges, and research competitions to inspire creativity and drive innovation. These events encourage problem-solving among students, researchers, and entrepreneurs. Offering winners funding, mentorship, and incubation support can help turn their ideas into practical, market-ready products and services. Leveraged AI technology to solve national problems such as youth unemployment, health promotion and education.	Medium

Table 12: Table of recommendations (continued)

Recommendation	Description	Priority
Develop funding mechanisms for AI projects	Establish AI-focused venture funds to support the design and development of AI solutions and the creation of an AI ecosystem. These funds will facilitate access to essential tools and talent, encouraging private sector investment in AI. This approach aims to drive innovation and deliver benefits to both public and private sectors.	Medium
Support the proposed RMF	Review the proposed RMF and adjust where necessary before its shared with other MDAs for implementation there-after, MDAs should support the collective implementation of this AI RMF.	Low
	Develop guidelines, standards, laws, policies supporting the AI enabling environment such as AI procurement guidelines, national AI policy, standards for algorithm impact assessment, AI monitoring and evaluation, AI incident response plan to support the implementation of this framework.	
	Encourage cooperation and collaboration within and between the MDAs implementing various AI technology through regular meetings and reporting to the AI National Task Force to respond to the opportunities and challenges of deploying AI for the country's socio-economic development economy.	
	Developing appropriate legal, ethical and safety standards on AI risks with potential to cause harm if regulations are not applied and for other types of protection that are not introduced or are not properly enforced, whether willingly or otherwise due to inadequate resources to support AI implemented in institutions.	
	Present the proposed RMF to the stakeholders for further consultation to ensure it is fit for purposes.	
	Train staff in AI risk management to support the implementation of this framework.	
	Appoint one AI officer of at least the rank of a principal officer in each MDA to champion and lead on the activities of AI and report to the Ministry of ICT and National Guidance at least twice a year.	
	Develop a checklist and comprehensive guideline emphasizing adherence to ethical standards, alignment with best practices, and prioritization of user safety and privacy, aiming to support AI adoption across sectors while minimizing potential risks.	
Identify AI projects and data sources for all stakeholders.	Identify AI projects, required data and source, custodian, purpose and data protection and privacy requirement for each stakeholder.	High

Table 12: Table of recommendations (continued)

Recommendation	Description	Priority
Award tenders for the supply of AI infrastructure, devices, accessories, and solutions to local companies and suppliers.	Award tenders for the supply of AI solutions to local companies to encourage the development of local expertise, retain financial resources within the economy, promote the localization of solutions, and spark greater interest in AI technology in Uganda.	High

Appendix 1

Baseline Survey – Questionnaires

Baseline Survey – **AI infrastructure, Standards, Initiatives, Human Capital, Policy Legal and regulatory frameworks for Uganda's AI Ecosystem**

Introduction

The Ministry of ICT and National Guidance with support from the International Telecommunication Union (ITU) is implementing a joint project on "Technical assistance and training to Uganda on National ICT development strategy" 2021-2024, The project aims to enhance Uganda's ICT policy and regulatory landscape, fostering the nation's ongoing transformation into a digitally empowered, innovative, and competitive society.

The main objective and purpose of the assignment is to develop recommendations for interventions that the Government of Uganda needs to make to ensure that the country can harness the economic and social benefits of Artificial Intelligence (AI) while minimizing its potential negative effects by putting in place the necessary policies, regulations, standards, human resources, stakeholders and underlying ICT infrastructure for AI technology and services. Artificial Intelligence aims to create systems that can simulate human intelligence and function independently. It can imitate human-like intelligence processes such as learning, reasoning, decision-making, and self-correction.

We wish to take a study to understand from your organization the AI Ecosystem, which is a key driver in the project. We would like to get your opinion regarding current policies, regulations, standards, human resources, stakeholders, and ICT infrastructure for AI in your organization.

Your responses will be kept confidential and combined with other responses when reporting the results.

Date…………………………………………………

Section 1: General Information

1.   Name of the Organization/Institution:

………………………………………………………………………………………………..

2.   Type of Institution:

- ☐   Government Agency
- ☐   Private Sector Organization
- ☐   International Organization
- ☐   Others, Specify……………………………………

3.   Position/Role of Respondent:

- ☐   Director/Executive
- ☐   Policymaker
- ☐   Researcher
- ☐   AI Specialist
- ☐   Data Scientist
- ☐   Legal Expert
- ☐   Policy Expert

> ◻   ICT Infrastructure Manager
> ◻   Others, Specify………………………………………

4.   Contact Information:

- •   Physical Address: ……………………………………
- •   Contact Person: …………………………………
- •   Phone Number: …………………………………
- •   Email: …………………………………

5.   Number of Employees in Your Organization:

> ◻   1-10
> ◻   11-50
> ◻   51-200
> ◻   200+

6.   Please describe the primary operations/mandate of your organization.

....

....

Section 2: AI Policies, Legal and Regulatory Frameworks

Objective: To assess the awareness, development, and implementation of AI-related policies, legal and regulatory frameworks in Uganda.

1.   Are you aware of any national-level AI policies, legal and regulatory frameworks in Uganda?

> ◻   Yes
> ◻   No

2.   Does your organization have any specific policies, laws and regulatory frameworks related to AI usage and development?

> ◻   Yes
> ◻   No
> ◻   Under development

    If Yes provide description...

    ....

3.   How do national policies (if any) impact AI innovation and deployment in your sector?

> ◻   Positively
> ◻   Negatively
> ◻   No Impact

    If positively explain the nature of the impact ....

    ....

4.   How do national legal and regulatory frameworks (if any) impact AI innovation and deployment in your sector?

☐   Positively
☐   Negatively
☐   No Impact

If positively explain the nature of the impact ....

5.   Select existing legal frameworks/initiatives in Uganda that address AI-related areas? (Select all that apply)

☐   Data Protection and Privacy
☐   AI Ethics and Fairness
☐   Intellectual Property Rights in AI
☐   AI Accountability and Liability
☐   Regulation of AI-based Decisions
☐   Human Rights in the Context of AI

6.   What specific gaps do you perceive in the current legal and regulatory frameworks/ initiatives around AI development and deployment?

....

7.   What areas do you believe should be prioritized for new regulations in Uganda's AI ecosystem?

☐   Autonomous Systems (e.g., drones, self-driving cars)
☐   AI in Financial Services (e.g., automated credit scoring)
☐   AI in Healthcare (e.g., diagnostic systems)
☐   Data Ownership and Privacy
☐   Bias and Fairness in AI Systems
☐   Cybersecurity of AI Systems
☐   Intellectual Property for AI-Generated Works

Others specify ....

Section 3: AI Standards, Policies, and Regulations

Objective: To assess the adoption of AI standards, policies, and regulations at both organizational and national levels.

1.   Does your organization adhere to international AI standards (e.g., ISO/IEC 42001:2023, ISO/IEC 23053:2022; ISO/IEC 23894:2023, ISO/IEC 25059:2023)?

☐   Yes
☐   No
☐   Under development

If Yes provide description...

2.   Are there sector-specific AI regulations that your organization follows (e.g., AI in finance, healthcare, or telecommunications)?

☐   Yes
☐   No

☐   Don't know

If yes, specify the sectors and regulations..

3.   How does your organization ensure ethical AI development and deployment?

☐   Internal AI Ethics Committees
☐   External Audits/Reviews
☐   Following AI Ethics Guidelines (please specify)

Other (specify) ....

4.   Does your organization have mechanisms in place to address algorithmic bias and fairness?

☐   Yes
☐   No
☐   Under development

5.   What challenges does your organization face when it comes to adhering to AI standards and regulations?

    ....

6.   Are there efforts to harmonize AI standards and policies across East African countries or the African Union?

☐   Yes
☐   No
☐   Don't know

If yes, describe these efforts ....

Section 4: Hardware and Infrastructure for AI

Objective: To evaluate the available hardware infrastructure and its sufficiency for AI development and deployment.

1.   What hardware infrastructure is available within your organization for AI development? (Select all that apply)

☐   Standard Servers
☐   Graphics Processing Units (GPUs)
☐   Tensor Processing Units (TPUs)
☐   High-performance Computing clusters
☐   Cloud-based AI Platforms (Specify provider)
☐   Edge computing device

Other (specify) ....

2.   What challenges do you face with your AI hardware infrastructure? (Select all that apply)

☐   High Cost of Equipment
☐   Lack of Skilled Personnel to Operate and Maintain Hardware
☐   Lack of capacity to Access to Cloud Services
☐   Inadequate Internet Bandwidth

Other (specify) ....

3. Are you currently using local data centers or relying on international cloud services for AI workloads?

    ☐   Local Data Centers (specify provider)
    ☐   International Cloud Services (specify provider)
    ☐   Both
    ☐   Don't know

4. What percentage of your AI-related computational needs are met by cloud infrastructure?

    ☐   0-25%
    ☐   26-50%
    ☐   51-75%
    ☐   76-100%

5. What investments in hardware infrastructure would significantly boost AI development in your organization?

....

Section 5: AI Applications and Use Cases

Objective: To explore how AI is being applied in different sectors and the current state of AI-driven innovations in Uganda.

1. Which AI applications are currently being developed or deployed in your organization? (Select all that apply)

    ☐   Natural Language Processing (e.g., chatbots, speech recognition)
    ☐   Computer Vision (e.g., image recognition, facial recognition)
    ☐   Predictive Analytics (e.g., forecasting, recommendation systems)
    ☐   Robotics and Automation (e.g., industrial robots, autonomous vehicles)
    ☐   AI in Healthcare (e.g., diagnostic tools, drug discovery)
    ☐   AI in Agriculture (e.g., precision farming, crop monitoring)
    ☐   AI in Finance (e.g., credit scoring, fraud detection)
    ☐   AI in Education (e.g., personalized learning systems)

Other (specify) ....

2. Which sectors show the greatest AI adoption potential in Uganda? (Rank the following from highest to lowest potential)

    ☐   Agriculture
    ☐   Finance
    ☐   Education
    ☐   Transportation
    ☐   Telecommunications
    ☐   Energy

Other (specify) ....

3. What are the key barriers to AI deployment in your sector?

....

4.   What would be the key drivers/benefits of AI adoption in your sector?

    ....

Section 6: Data Management and Governance

Objective: To assess the quality of data management practices and the governance structures around AI datasets in Uganda.

1.   Does your organization collect and store large datasets for AI applications?

    ☐   Yes
    ☐   No
    ☐   Don't know

2.   What types of data storage systems does your organization use for AI data?

    ☐   On-Premises Servers
    ☐   NITA-U Servers
    ☐   Cloud Storage
    ☐   Data Lakes
    ☐   Data Warehouse
    ☐   Distributed File System

    Other (specify) ....

3.   Does your organization implement the following data governance practices? (Select all that apply)

    ☐   Data Encryption
    ☐   Access Control Policies
    ☐   Data Anonymization
    ☐   Regular Data Audits
    ☐   Compliance with Local Data Protection Laws
    ☐   Compliance with GDPR or other international data privacy standards

    Other (specify) ....

4.   What are the primary challenges you face in data management for AI?

    ....

5.   How important are data privacy regulations (e.g., Uganda's Data Protection and Privacy Act) to your AI work?

    ☐   Very Important
    ☐   Important
    ☐   Not Important

6.   Is there a need for new or updated data governance frameworks specifically tailored to AI?

    ....

Section 7: AI Skills, Capacity, and Human Resources

Objective: To identify the current state of AI talent and skills in Uganda and evaluate workforce preparedness.

1.   Does your organization currently employ individuals with AI-related skills?

☐   Yes
☐   No
☐   In Development

2.   Which AI skills are most in demand within your organization? (Select all that apply)

☐   Machine Learning
☐   Data Science
☐   Natural Language Processing
☐   AI Software Engineering
☐   AI Hardware Development
☐   AI Cybersecurity

Other (specify) ....

3.   What types of training or capacity-building programs are needed to develop AI talent in Uganda?

....

4.   How do you assess the capacity of Uganda's educational institutions to produce AI-ready graduates?

☐   Very Adequate
☐   Adequate
☐   Inadequate
☐   Don't know

5.   What are the primary challenges your organization faces in attracting and retaining AI talent?

....

6.   Is your organization currently involved in any AI training or capacity-building initiatives (internally or with external partners)?

☐   Yes
☐   No
☐   In Development

If yes, please describe the nature of these programs ....

7.   In your opinion, what is the most significant barrier to developing AI talent in Uganda?

☐   Lack of AI-specific educational programs
☐   Lack of practical, hands-on AI training
☐   Limited research and development opportunities
☐   Limited awareness of AI career opportunities

Other (specify) ....

Section 8: Recommendations and Future Outlook

1.   What specific policies or regulatory actions should the Ugandan government prioritize to enhance AI readiness?

2.   What types of partnerships or collaborations (local or international) could accelerate AI development in Uganda?

3.   How do you envision the role of AI in transforming Uganda's economy in the next 5-10 years?

4.   What are the top 3 sectors where AI can provide the most significant benefits in Uganda?

5.   What support (financial, technical, policy) would be most helpful in developing AI solutions in Uganda?

6.   In your view, what key trends in global AI development should Uganda focus on?

7.   Please provide any additional recommendations or thoughts on how Uganda's AI ecosystem can be improved.

Baseline Survey - AI Risks and Mitigation Measures in Uganda's AI Ecosystem

Introduction

The Ministry of ICT and National Guidance with support from the International Telecommunication Union (ITU) is implementing a joint project on "Technical assistance and training to Uganda on National ICT development strategy" 2021-2024, The project aims to enhance Uganda's ICT policy and regulatory landscape, fostering the nation's ongoing transformation into a digitally empowered, innovative, and competitive society. The main objective and purpose of the assignment is to develop recommendations for interventions that the Government of Uganda needs to make to ensure that the country can harness the economic and social benefits of Artificial Intelligence (AI) while minimizing its potential negative effects. Artificial Intelligence aims to create systems that can simulate human intelligence and function independently. It can imitate human-like intelligence processes such as learning, reasoning, decision-making, and self-correction.

Artificial Intelligence can amplify organizations' exposure to potential risks, ranging from human rights, fairness, privacy, safety, transparency, accountability and security issues to regulatory fines and reputational harm. We wish to take a study to understand from your organization the AI Ecosystem risks you are faced with in your organization.

Your responses will be kept confidential and combined with other responses when reporting the results.

Date………………………………………………….

Section 1: General Information

1.   Name of the Organization/Institution:

………………………………………………………………………………………..

2.   Type of Institution:

- ☐   Agriculture
- ☐   Health
- ☐   Education
- ☐   Academia
- ☐   Finance
- ☐   Manufacturing
- ☐   Agency
- ☐   Telecommunication
- ☐   Transportation
- ☐   Banking
- ☐   Private Sector Organization

       Other (specify) ....

3.   Position/Role of Respondent:

- ☐   Director/Executive
- ☐   Policy maker
- ☐   Researcher
- ☐   AI Specialist
- ☐   Data Scientist

☐   Legal Expert
☐   Policy Expert
☐   ICT Infrastructure Manager

Other (specify) ....

4.   Contact Information:

- Physical Address: …………………………………..
- Contact Person: ……………………………………
- Phone Number: ……………………………………
- Email: …………………………………....................

Section 2: Assessment of AI Risks and Mitigation Measures

1.   Does your Ministry, organization, department or company deploy or intend to deploy AI systems (including third-party models or those that serve as inputs into other models)?

☐   Yes
☐   No

2.   What type(s) of outputs or services does your AI provide?

i.   ....

ii.   ....

iii.   ....

iv.   ....

if so, provide documentation of the models.

3.   Is your organization using any of these detailed standards or best practices for AI Risk Management

☐   ISO/IEC 42001:2023 Artificial intelligence --Management systems
☐   National Institute of Standards and Technology. Artificial Intelligence Risk Management Framework (AI RMF 1.0)
☐   Machine Learning System Security Guidelines version 2.00
☐   Code of Conduct for Developers of AI Systems
☐   AI Guidelines for Business (Version 1.0)
☐   NIST Standard Machine Learning Quality Management Guidelines
☐   Info comm Model AI Governance Framework
☐   EU ACT on AI Systems
☐   Japanese Guidelines for AI systems
☐   Others state ....

4.   What kind of people or organization(s) does each of your AI model potentially impact?

☐   Public
☐   Customers
☐   Government service delivery
☐   Employees
☐   Others state ....

5.	Does your organization or company have response plans in place to address AI/ML incidents?

☐	Yes
☐	No

If Yes specify the plan ....

6.	Is your organization/company aware of how AI models affect different customer segments?

☐	Yes
☐	No

If yes provide documentation on the models

7.	Rate in your own terms the likelihood and impact of AI/ML risks associated with your organization by ticking in appropriate box below.

Risks	Likelihood			Impact		
	Low	Moderate	High	Low	Moderate	High
Infringe on fundamental human rights						
Unfairness/Algorithmic bias						
Breach of privacy						
Breach of computer security						
Safety						
Insufficient accountability						

8.	What strategies does your organization employ to mitigate AI risks?

☐	Avoid
☐	Mitigate/Reduce
☐	Accept
☐	Transfer

9.	Is your organization's AI models audited for security or privacy vulnerabilities?

☐	Yes
☐	No

If yes, who are the auditors (s)? ....

10.	Has any independent third party or other external experts (regulators, international standard bodies such as ISO, or others) been involved in reviewing your AI systems for compliance?

☐	Yes
☐	No

If yes, who are the third parties ....

Appendix 2

The AI National Task Force shall:

a) Ensure that each MDA has a designated AI officer responsible for coordination of AI activities within the MDA. When the designated AI Officer position falls vacant, the MDA must notify the national task force within a period of not more than 60 days.

b) Ensure that each MDA submits to the national task force and posts on its website, a plan or written statement of the AI project its implementing or plan to implement including plans to update its guidelines or standards in line with this AI risk management framework. The AI National Task Force through the Ministry of ICT and National Guidance will provide this template to each MDA.

c) Ensure that each MDA keeps inventory of its AI use cases, submit the inventory to the National Task Force, The National Task Force through the the Ministry of ICT and National Guidance will issue instructions for the AI use case report including its scope and list of high risks, impact and how the MDA is managing the AI high risks.

d) Ensure that the appointed AI Officer to by the MDA is a Senior Officer to ensure that the individual is fully accountable.

Appendix 3

The Accounting Officer of each MDA shall be responsible for:

a) Convening of an internal AI governance body meetings to coordinate departments officials responsible for aspects of AI adoption and risk management.

b) Removing barriers to the use of AI and managing associated risks.

c) Having membership of the internal AI governance meet at least twice a year and with relevant membership composition of at least IT, cybersecurity, data, privacy, civil rights and civil liberties, equity, statistics, human capital, procurement, budget, legal, agency management, customer experience, programme evaluation, and officials responsible for implementing AI within the MDA office(s).

d) Consulting external experts as appropriate and in accordance with the law to broaden their perspective on AI governance and risk management as well obtain technical advice on Cyber security, privacy and workforce sensitization.

e) Implement responsible AI innovations and risk management practices to ensure a safe and secure AI for effective delivery of service to the public.

Appendix 4

Roles of MDA's AI Officers

AI officers shall be responsible for the coordination of AI activities, promoting AI innovations and managing AI risks within the MDAs. The AI officers must be at a senior level position, within the MDA. The officer must be at least at the level of Principle officer and above able to engage with departmental heads and the accounting officer on the use of AI.

Reporting Structure

AI Officer should report to the organization Accounting Officer

Responsibilities

The roles and responsibilities of AI officers are:

Coordinating AI Activities

a)   Serve as the Senior advisor for AI initiatives to the MDA senior decision-making forums.

b)   Instituting the requisite governance and oversight processes to achieve compliance with this AI risk management framework and enable responsible use of AI in the MDA, in coordination with relevant officials.

c)   Maintain awareness of MDA AI activities, including through the creation and maintenance of the annual AI use case inventory.

d)   Develop a plan for compliance with this AI risk management framework.

e)   Work with and advise the MDA's accounting officer on the resourcing requirements necessary to implement this framework and provide recommendations on priority investment areas to build upon existing AI implementation capacity.

f)   Maintain the skillsets necessary for using AI to further the MDA's mission and adequately manage its risks.

g)   Share relevant information with MDA officials involved in the agency major AI policymaking initiatives.

h)   Support MDAs involvement with appropriate inter-MDAs coordination bodies related to their MDA AI activities, including representing the MDA on the national AI task force forum.

i)   Support and coordinate their MDA involvement in AI standards-setting bodies, as appropriate, and encouraging agency adoption of voluntary consensus standards for AI, as appropriate and consistent with National AI task force circular as applicable.

j)   Promoting AI innovation.

k)   Identify and prioritize appropriate uses of AI that will advance both their MDA mission and equitable outcomes.

l)   Identify and remove barriers to the responsible use of AI in the MD including through the advancement of AI-enabling enterprise infrastructure, data access and governance, workforce development measures, policy, and other resources for AI innovation.

m)   Working with organization chief information officers, accounting officers, and other relevant officials to ensure that custom-developed AI code and the data used to develop and test AI are appropriately inventoried, shared, and released within their MDA and to the public on the opportunities and benefits of AI to the agency mission.

Managing risks associated with the use of AI

a)   Support the MDA in identifying and managing risks from the use of AI, especially safety, security and trustworthiness.

b)   Work with relevant Senior MDA officials to establish or update processes to measure, monitor, and evaluate the ongoing performance and effectiveness of the MDA AI applications and whether the AI is advancing the MDA mission and meeting performance objectives.

c)   Oversee MDA compliance with requirements to manage risks from the use of AI, including those established in this framework and in relevant law and policy.

d)   Conduct risk assessments of AI applications.

e)   Work with relevant MDA officials to develop supplementary AI risk management guidance to the MDA mission, including working in coordination with officials responsible for privacy and civil rights and civil liberties on identifying safety-impacting and rights-impacting AI within the MDA.

f)   Review individual applications of AI from elements of this RMF in partnership with relevant MDA officials (e.g., procurement, legal, data governance, human capital, and oversight officials).

g)   Establish controls to ensure that their MDA does not use AI that is not in compliance with this including by assisting these relevant agency officials in evaluating Authorizations to Operate based on risks from the use of AI.

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