Assessment of the big data landscape in Uganda

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Acknowledgements

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Foreword

In our pursuit of a digitally empowered Uganda, the role of big data has never been more critical. As we implement the Digital Uganda Vision and the broader National Development Plans, the ability to harness data for improved service delivery, evidence-based planning, and innovation is central to our transformation agenda. This **Assessment of Uganda's big data landscape** marks a pivotal step in that direction.

This report is not just a diagnostic exercise. It is a reflection of where we stand, where we must go, and what it will take to build a robust data-driven culture in the public sector and beyond. Undertaken through a consultative process involving Ministries, Departments and Agencies, academia, private sector players, and development partners, the assessment provides invaluable insights into the opportunities, constraints, and maturity of our big data ecosystem.

The findings are both sobering and encouraging. While most of our institutions remain at early stages of big data adoption with limited infrastructure, skills, and regulatory alignment, the commitment to change is clear. The Ministry of ICT and National Guidance, working with our partners, is determined to turn this baseline into a foundation for real progress. We must invest in infrastructure, build human capital, reform data policies, and foster inter-agency collaboration if we are to reap the full benefits of data in our national development journey.

As Minister, I am particularly heartened by the momentum this assessment has created towards finalizing and operationalizing both the Big Data Utilization Strategy (2023–2027) and the National Data Strategy. These instruments are not ends in themselves; they are tools to enhance the quality of life of our people by ensuring government decisions are smarter, services are more efficient, and opportunities are equitably distributed.

I commend the teams from the Ministry, our consultant, the International Telecommunication Union (ITU), and all stakeholders who contributed to this effort. This report must serve not as a shelf document, but as a practical guide for implementation. I invite all actors, government agencies, the private sector, civil society, academia, and our international partners to join us in actualizing the vision of a data-driven, inclusive, and innovative Uganda.

Let us act boldly, for the future belongs to those who harness the power of data today.

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 fueling 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.

I encourage ITU Member States across the African 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 rapid evolution of digital technologies has fundamentally transformed how governments globally deliver services, foster economic growth, and drive innovation. In line with Uganda's Vision 2040, the Third National Development Plan (NDPIII), and the Digital Uganda Vision (DUV), the Government of Uganda, through the Ministry of ICT and National Guidance, is committed to harnessing the power of big data to accelerate our journey towards becoming an inclusive, competitive, and knowledge-based growing economy.

This report with an **Assessment of Uganda's big data landscape**, marks a critical step forward in understanding our Uganda's preparedness and potential for effective Big Data utilization. Conducted as part of the Project on Technical Assistance and Training to Uganda on National ICT Development Strategy, with technical support from the International Telecommunication Union (ITU) and funded by the Global Development and South-South Cooperation Fund (GDSSCF), this report offers a comprehensive analysis of the current state, challenges, and opportunities within Uganda's emerging big data ecosystem.

The findings are clear and instructive. Despite some strides made in digital policy and governance frameworks, many Government Ministries, Departments, and Agencies (MDAs) are still at a foundational maturity level regarding infrastructure, human resources, and practical big data applications. Critical barriers identified include gaps in infrastructure, limited human resource capacity, insufficient data management practices, and regulatory challenges around data governance and interoperability.

This assessment, enriched through comprehensive stakeholder engagements - including key public institutions, private sector entities, academia, and development partners - provides actionable insights into the gaps in Uganda's big data capabilities. It also identifies successful international practices and regional benchmarks that Uganda can leverage to create a vibrant, inclusive, and sustainable big data ecosystem.

A key strength of this report lies in its alignment with the Digital Transformation Roadmap (2023-2028), underscoring the need for coordinated policy actions, investment in infrastructure, enhanced capacity building in big data analytics, and effective regulatory frameworks to ensure data protection and privacy. By addressing these dimensions comprehensively, Uganda can unlock significant socio-economic value from data-driven innovation and analytics.

I commend the collaborative efforts of all stakeholders who contributed to this essential baseline assessment. As we move forward, I urge all government agencies, development partners, the private sector, and academia to actively engage with the recommendations outlined in this report, ensuring their effective implementation. Together, we can position Uganda strategically to fully realize the transformative potential of big data, paving the way for inclusive and sustainable development across our nation.

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

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Abbreviations

BD	Big data
BDA	Big data analytics
BDUS	Big Data Utilization Strategy (2023-2027)
Enabel	Belgian Development Agency
ETL	Extract, load and transform
GIZ	German Agency for International Corporation
GWG	Global Working Group on Big Data for Official Statistics
ICT	Information and communication technology
ITU	International Telecommunication Union
JICA	Japan International Cooperation Agency
MDA	Public sector entities such as ministries, departments and agencies
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoICT&NG	Ministry of ICT and National Guidance
NGO	Non-governmental organization
NITA-U	National Information Technology Authority – Uganda
SQL	Structured Query Language
UCC	Uganda Communications Commission
UNCDF	United Nations Capital Development Fund
UN-CEBD	United Nations Committee of Experts on Big Data and Data Science for Official Statistics
UNDP	United Nations Development Programme

Executive Summary

Overview

This assessment of Uganda's big data landscape was commissioned by the Uganda Ministry of ICT and National Guidance and carried out with support from ITU. It includes a proposal for a training programme to enhance the skills of government officials to apply and use big data, and thereby improve service delivery. The assessment was conducted under the ITU–Government of Uganda project Technical Assistance and Training to Uganda on National ICT Development Strategy. The project is implemented by ITU and the Government of Uganda, with the Ministry acting as the lead agency. The South-South Cooperation Assistance Fund, through its representative partner, the Ministry of Industry and Information Technology of the People's Republic of China, provided financial support.

Rationale for the assessment

The assessment was conducted to contextualize and determine the current state of Uganda's big data ecosystem for a network of organizations, particularly those in the public sector, and the extent to which they have adopted and integrated big data into ongoing operations. It was specifically conducted to determine the country's big data maturity level, especially in the public sector. The results are intended to help the Uganda Government, the private sector and key development partners work on potential big data projects under the Big Data Utilization Strategy (2023–2027), which is aligned with Uganda's Third National Development Plan (NDP III), the Digital Uganda Vision and the draft National Data Strategy. The assessment also identifies gaps in the Big Data Utilization Strategy and leverages international best practices of countries successfully implementing their big data strategies.

Methodology

Mixed methods research (a combination of qualitative and quantitative research) was used to conduct the assessment. The qualitative analysis included a desktop review of various reports, journals, documents and other reference materials related to big data use in Uganda (see References). The quantitative data analysis included processing of data collected from various public sector entities (ministries, departments and agencies) and from selected private sector entities. A big data maturity assessment model, developed by the Global Working Group on Big Data for Official Statistics (GWG) (now the Un Committee of Experts on Big Data and Data Science for Official Statistics (UN-CEBD)), was used to draw up a contextualized questionnaire for assessing some of the key government ministries and agencies identified through the rapid stakeholder analysis of (potential) big data adopters and users in Uganda.

The model is a self-assessment framework that helps public sector organizations measure, among other things, their level of big data adoption. It comprises four maturity levels, i.e. pre-foundation, foundation, practitioner and expert, and four themes, i.e. legal and policy frameworks, IT infrastructure, human resources and application of big data. An organization is said to be at:

- Pre-foundation level when it has not yet or is at the very start of its big data journey (just thinking of putting in place big data frameworks);

- Foundation level when big data frameworks are being developed and a small number of big data projects are under way but on an ad hoc or uncoordinated basis;
- Practitioner level when big data frameworks have been developed and big data projects are under way and being managed in a strategically coordinated way;
- Expert level when data science is well embedded and extensively applied within the organization, to the extent that the organization trains its staff internally and can even train other organizations in big data application.

Key findings

Legal and policy frameworks

The majority (60.9%) of the public sector entities assessed were at the pre-foundation maturity level in terms of legal and policy frameworks for big data, meaning that they had not yet developed or ere just planning to put in place legal and regulatory frameworks related to big data.

Two out of the country's three telecommunication operators were at the practitioner maturity level in terms of legal and policy frameworks for big data, with the third at foundation level. Four out of the country's 34 commercial banks were at foundation or practitioner maturity level, respectively, in terms of legal and policy frameworks for big data. The rest were at the pre-foundation maturity level.

Uganda has high-quality laws and regulations relevant to the big data ecosystem. Unfortunately, enforcement of those laws and regulations is wanting.

While the Uganda Bureau of Statistics is mandated to coordinate government-wide data collection, it has struggled to bring other agencies into the national statistics system.

No government agency is mandated to coordinate data management, and the resulting void means that the matter is largely unattended to.

The Big Data Utilization Strategy is well structured but lacks a complete implementation framework with clear targets, allocation of roles and responsibilities, costs, and a monitoring and evaluation framework.

There is limited awareness among stakeholders of the existing policy, legal and regulatory frameworks for data in Uganda.

There is limited regulation of data held by non-State actors such as telecommunication and tech companies (including cross-border data flows from those domiciled outside Uganda but accessible there).

Existing regulations focus on personal data protection. The regulation of non-personal data, which is equally important, is not considered.

Big data infrastructure

A majority (73.9%) of the public sector entities assessed were at the pre-foundation maturity level for big data infrastructure, meaning that they did not have infrastructure configured to collect and apply big data. Nine per cent were at the foundation and 5 per cent at the practitioner maturity level.

Two of the three main telecommunication companies were at the practitioner level for big data infrastructure, with one having such infrastructure within the country while the other's infrastructure was housed outside the country. Twenty-three per cent of financial institutions reported having the necessary infrastructure for big data adoption, with 60 per cent most likely to invest in infrastructure. In all, 64.2 per cent of public sector entities had embraced cloud computing services.

Fifty-nine per cent of the public sector entities assessed offered services to the public online.

The data centre at NITA-U has the infrastructure needed to store and analyse big data if configured, and 54.1 per cent of public sector entities were using cloud services offered by the government through NITA-U.

Human resources for big data analytics

The majority (87%) of the government ministries and agencies assessed were at the pre-foundation maturity level in terms of human resources for big data, meaning that they did not have or were just planning to hire expertise to implement big data projects.

All the telecommunication companies and 52 per cent of the commercial banks assessed had data analytics departments with staff able to handle big data or being trained to do so.

Sixty-four per cent of the IT and statistics staff at the public sector entities reported being aware of big data sources within their organization. All relevant staff at the telecommunication companies and commercial banks were aware of big data.

The staff members interviewed used varying definitions of big data and had their own views of what it is.

The skill sets needed to implement big data analytics were lacking in most sectors, according to the big data competency assessment. For example, 26 per cent of staff reported being trained in big data relational databases.

Eighty per cent of staff in the public sector entities assessed had foundation competency in data management and 69 per cent had foundation competency in programming at the very least. These are prerequisites for anyone to be properly trained in big data analytics.

Application of big data analytics

The majority (91.3%) of the country's public sector entities were at the pre-foundation big data maturity level, meaning that most had not applied any big data tasks or such tasks were undertaken on an ad hoc basis by individual employees, out of interest. The remaining 8.7 per cent were at the foundation maturity level for infrastructure.

Data management systems were common across public sector entities but had limited inter-connectivity and many were not being used optimally. This presents a challenge in that holistic analysis and use of data, including possible big data analysis, is curtailed.

Data access remains a general problem in Uganda. According to the majority of the interviewees, the biggest problem is the inability to access primary big datasets from data producers, mainly out of fear that data privacy regulations will be violated and/or sensitive information exposed.

There is a culture of limited data use in Uganda, especially among public sector entities and the people who work for them.

Uganda's (big) data ecosystem faces a major financing problem. There is not enough funding for data activities, especially pilot projects. The funding that does exist for the few big data pilot projects comes primarily from donors.

Recommendations

Legal and policy frameworks

Legal and policy reforms concerning big data utilization should be introduced urgently and as required. The Access to Information Act 2005, the Electronic Transfers Act 2011 and the Data Privacy and Protection Act 2019 specifically need to be amended to include regulation of non-personal data and to boost clarity and enforcement. Awareness of these acts, especially those related to responsible data-sharing, needs to be heightened.

Public sector entities with no internal data governance frameworks setting out data management regulations and guidelines should be encouraged and helped to develop them.

A national policy is needed to govern data at both government and non-State level and the draft Open Data Policy 2017 should be finalized.

The Uganda Bureau of Statistics and the Ministry of ICT and National Guidance need to spearhead the strengthening of the Big Data Utilization Strategy by reviewing and finalizing the proposed implementation framework.

Big data infrastructure

If the Government wants to obtain tangible results from the Big Data Utilization Strategy, it must invest in the technical infrastructure (both hardware and software) needed for big data analytics, with a coordinated support mechanism from development partners.

A business model is needed that outlines roles and responsibilities, beneficiaries and funding arrangements for a successful big data initiative. Sustainability is also key.

Existing regional and continental big data promotion initiatives should be leveraged to promote big data infrastructure and human resource development. Public-private partnerships should be explored and brokered to finance proposals to set up big data infrastructure and human resource capacity building

Big data human resources

In order to build capacity at the national level, public sector IT cadres and statisticians should be gradually trained in practical big data use after foundational big data awareness has been imparted to policy-makers. Training for the relevant public sector staff should be coupled with pilot use cases for big data applications.

Big data application

The implementation of big data pilot use cases by targeted public sector entities is a more effective means of promoting awareness and the culture of data use, especially big data use.

Coherence among government players and development partners should be improved, so as to make efficient use of the financial resources allocated to potential data initiatives, including those for big data.

Public-private partnerships should be explored and participation in regional big data promotion bodies (e.g. the United Nations Regional Hub for Big Data and Data Science in Africa/UN-CEBD Regional Hub for Africa and the East African Regional Digital Integration Project) increased, to finance and obtain guidance on planned big data applications.

1   Introduction

This report presents the results of the assessment of Uganda's big data landscape. In September 2023, the Government of Uganda launched the Big Data Utilization Strategy 2023–2027 to enable it to make data-driven decisions that will drive economic growth. At the same time, work is being done to develop the National Data Strategy, with elements of nascent data technologies, such as big data analytics, being promoted.

The results of this assessment support the Government's implementation of the Big Data Utilization Strategy, which is aligned with Uganda's Third National Development Plan (NDP III), the Digital Uganda Vision 2040 and the complementary national Digital Transformation Roadmap 2023/24–2027/28. The assessment also contributes to the national Digital Transformation Roadmap for achieving the Digital Uganda Vision, by assessing the baseline status of available big data in the country. It may inform the finalization and implementation of Uganda's Fourth National Development Plan (NDP IV). The big data development interventions proposed in the strategy involve data resource evaluation, data science capacity development and big data project pilots. As such, the strategy aspires to help transform Uganda into a data-driven society and foster big data opportunities for sustainable growth. Under the National Development Plan and Digital Uganda Vision, digital transformation is pivotal for inclusive growth and service delivery improvement.

This assessment was undertaken as part of the Technical Assistance and Training to Uganda on National ICT Development Strategy project jointly implemented by the Government of Uganda and ITU. The Ministry of ICT and National Guidance is the lead project implementing agency and financial support is provided by the South-South Cooperation Assistance Fund/, with the Ministry of Industry and Information Technology of the People's Republic of China as its representative partner in the project. The project's main objective is to help strengthen Uganda's ICT policy and regulatory environment, so as to enable the country to pursue its transformation into a digitally enabled society that is innovative and competitive.

The assessment is anchored in the digital infrastructure and connectivity pillar of the Digital Uganda Vision and follows the same three-pronged approach as the ITU Technical Assistance and Training to Uganda on National ICT Development Strategy project, which is to:

- Develop policy recommendations: The project will work with stakeholders to develop recommendations for big data utilization policy and planning.
- Build capacity: The project will assess the capacity to develop training programmes and support for those working in ICT, statistics and monitoring/evaluation in big data analytics.
- Implement pilot projects: The project supports the identification of pilot projects that demonstrate the benefits of big data adoption and usage.

1.1   Big data

The term "big data" refers to datasets that are too big for traditional or typical database software tools to capture, store, manage and analyse (Loschin, 2013; Berman, 2018; Birkin, 2020). It is used to describe large volumes of high velocity, complex and variable data that require advanced techniques and technologies (big data analytics and big data analytics tools, respectively) to capture, store, distribute, manage and analyse the information.

The definition of big data varies from sector to sector and from industry to industry, depending on the capabilities of the organization managing the dataset and the applications being used to process and analyse it (Caesarius and Hohenthal, 2018). For example, hundreds of gigabytes of data may be considered big data in one organization, whereas in another big data may be tens or hundreds of terabytes. Big data is now characterized by what are called the 5Vs: volume (the size of the data), variety (the type and nature of the data), velocity (the speed at which the data are generated), variability (dataset inconsistency) and veracity (the quality of the data). In Uganda, big data includes mobile phone data/call data records, satellite/aerial/road camera imagery, health records, and social media and radio data.

1.2   Big data analytics

Big data analytics is the use of advanced techniques and tools that derive sense and meaning from very large, diverse datasets containing structured, semi-structured and unstructured data, obtained from different sources and in different sizes, from terabytes to zettabytes (Loschin, 2013; Birkin, 2020). It is used to receive and store data generated from a range of sources, including digital processes, social media, sensors and mobile devices, and employs analytics to gain useful insights to guide decision-making. Advances in both storage technology and computing power have made it feasible to collect and store data of this type (Berman, 2018).

Big data analytics can also refer to the tools and methodologies used to transform massive quantities of raw data (structured and unstructured) into meaningful information for analytical purposes (Berman, 2018). According to Birkin (2020), big data analytics has traditionally been expensive and inefficient; careful investments will be needed if opportunities are to be realized in full. Examples of big data analytics technology include database infrastructure and analytic software tools. Good big data database tools include Hadoop, an open-source Apache product, and Not Only SQL (NoSQL) databases, which do not have the significant upfront licence costs of traditional systems. Thanks to these tools, it is becoming more affordable to set up an analytics platform. NoSQL is a type of database management system designed to handle and store large volumes of unstructured and semi-structured data. Unlike traditional relational databases, which use tables with pre-defined schemas to store data, NoSQL databases use flexible data models that can adapt to changes in data structure and be scaled horizontally to handle growing amounts of data. Examples of good software tools that can be used to analyse big data include R, PySpark, Apache Spark and Python.

1.3   Status of digitalization and big data in Uganda

The Digital Uganda Vision 2040 is a national policy and strategic framework aimed at implementing Uganda's National Vision 2040 by building a digital society that is secure, sustainable, innovative and transformative, so as to create positive social and economic impact through technology-based empowerment. The Digital Uganda Vision is a framework that reviews, integrates, consolidates and improves all existing ICT strategies, policies and plans in one overarching digital vision for Uganda, providing a unified direction for ICT development and an integrated ICT project implementation approach.

The principal aim of the Digital Uganda Vision is to align ICT investments in the various sectors in a manner that will improve the country's global ICT indices for the purpose of attracting investors. The Ministry of ICT and National Guidance will define digital milestones to avert duplication and ensure the cumulative impact of investments in ICTs.

DataReportal (Kemp, 2024) and Research ICT Africa report on the state of ICT in Uganda, focusing on the Digital Uganda Vision 2040. According to them, certain policy interventions and lack of government coordination threaten the vision's effective implementation. These include (a) low Internet and mobile network penetration due to poor ICT infrastructure, poverty and low levels of digital literacy; (b) the cost of data and devices, which is too high for most to access the Internet; (c) poor telecommunication market concentration, particularly outside urban areas where there is a duopoly; (d) the absence of demand stimulation encouraging people to shift from passive consumption to productive use of ICT; and (e) the failure to lower the cost of access and use models to promote dynamic spectrum use in rural areas.

Uganda had a grade of 34.8 on the ITU ICT Development Index in 2023, with 85 per cent of the population covered by at least a 3G mobile network and 13 per cent covered by at least a 4G/LTE mobile network. About 65 per cent of the population owned phones but only 10 per cent could access the Internet. The mobile broadband penetration rate stood at 52.2 per 100 inhabitants; according to the national Digital Transformation Roadmap 2023, Uganda thus ranks below the average nationwide mobile phone penetration rate in Africa of 74.60 per 100 inhabitants. The Global Connectivity Index ranks the country 77th out of 79. Even though the country's Internet penetration rate is an average 43 per cent due to limited infrastructure, the number of registered Internet users has grown steadily over the years, to over 13.3 million in January 2024 from 11.7 million in January 2023 (Kemp, 2024). This is a proxy indicator showing an increase in the development and consumption of ICT services in the country.

When it comes to network readiness, Uganda ranked 117th out of 134 on the Network Readiness Index in 2023. The index has four pillars: technology, people, governance and impact (growth and well-being in society and the economy). Uganda's main strength related to governance. The index also ranked Uganda as 15th in Africa in the group of low-income countries.

According to the World Bank's GovTech Maturity Index, Uganda's position rose from 0.639 in 2020 to 0.858 in 2022, lifting it from Group B to Group A of GovTech leaders. This shows that Uganda has improved across all four core areas considered in the GovTech Maturity Index: government systems, public service delivery, digital citizen engagement and GovTech enablers.

Uganda is also one of the countries using the UNCDF Inclusive Digital Economy Scorecard, which identifies catalyst areas that spur the growth of an inclusive digital economy. A country undertaking the assessment can identify priority interventions for accelerating the advent of a robust digital economy in terms of policy and regulation, infrastructure, innovation and skills. The latest assessment for Uganda, for 2022, shows that the country rated 43 per cent in the skills domain compared to 33 per cent in 2020; 80 per cent in the policy and regulation domain compared to 77 per cent in 2020; 42 per cent in the innovation domain, as in 2020; and 56 per cent in the infrastructure domain compared to 51 per cent in 2020.

Overall, the above findings show that Uganda scores highly on digital policy and regulation and lower when it comes to digital skills, innovation, inclusiveness and infrastructure.

In terms of what has been achieved so far to achieve the Digital Uganda Vision, a number of interventions have been undertaken. For example, a recent UNESCO quadrennial report on Uganda refers to the establishment of the Rural Communications Fund, the Government Enterprise Architecture and the E-Government Interoperability Framework, which will facilitate coordination and delivery of integrated services across government public sector entities as

identified in the Digital Vision Uganda by ensuring better interoperability and optimal use of ICT infrastructure.

The country had about 33 million mobile subscriptions at the end of January 2024, up from 30 million in 2018, according to the UCC and Kemp (2024). Other critical indicators and associated targets are presented in Table 1 below.

Table 1: Selected data and ICT-related indicators

Indicator	Baseline (2018)	Targets 2023	Current status 2023
Internet penetration	25%	43%	27%
Population covered by mobile cellular connections	30.56 million	N/A	33.34 million
Proportion of government services (online)	20%	61%	59%
Proportion of social media users	6%	N/A	6%
ICT Development Index	21.9*	36	34.8
Number of legal and regulatory frameworks related to ICT and data developed/reviewed	0	4	1

* This was the 2017 value which was actually 2.19, before ITU's change in calculation methodology

Source: Digital Uganda Vision 2022, the ICT Development Index 2023 and Kemp, 2024.

Technological advances will have a significant impact on Uganda's data strategy. Artificial intelligence, the Internet of Things, cloud computing and blockchain are the big data-generating technological advances being considered for promotion in the country.

The adoption and use of big data are heavily contingent on better interoperability and optimal use of ICT infrastructure in the country. The digital footprint of the country's myriad players, from Internet and social media users to radio pundits, constitutes a good source for the collection of big data. Big data adoption and use are also contingent on the existence of the policies, skilled human resources and infrastructure needed to analyse and use big data.

According to the literature, in low- and middle-income developing countries like Uganda, big data is a radically new concept in several sectors (Hasan, Popp and Oláh, 2020; Kihangire, 2022). With specific reference to Africa, the adoption of big data has been studied in general terms across selected sectors: the telecommunication industry in South Africa (Walker and Brown, 2019), the manufacturing sector in Morocco (Belhadi et al., 2019), the education sector in sub-Saharan Africa (Umezuruike and Ngugi, 2020) and the retail sector in Kenya (Ochieng, 2015). According to Umezuruike and Ngugi (2020), the developed economies have made large strides towards the adoption and use of big data analytics, but the same cannot be said of the developing economies in sub-Saharan Africa.

According to the Big Data Utilization Strategy, Uganda's big data ecosystem is in the early stages of development, in both government and the private sector. Some initiatives have been taken to improve data collection, management and analysis with a view to harnessing big data. According to the strategy, examples include the Ministry of Finance, Planning and Economic Development, which uses its budget website to collect and produce large volumes

of varied disaggregated financial data, data from district work plans and performance reports that can constitute big data. The strategy also mentions that the Uganda Bureau of Statistics curates data collected by it and a number of other administrative systems publishing a range of nationally aggregated statistics on a relatively timely basis. The Ministry of ICT and National Guidance established the Parish Development Model Information System, which says that the data it collects at the level of the parish, to aid data-driven community support planning, can be configured to collect and analyse big data.

Uganda is becoming more and more digital but continues to rank below average, with a mobile Internet penetration rate of 27 per cent against the Third National Development Plan 2023 target of 43 per cent and with over 13 million Internet users. Furthermore, the widespread adoption of mobile technology and consequent use of social media such as Facebook, Twitter (now X) and WhatsApp on mobile phones has not only made the use of digital platforms the norm but has also given rise to yet another revolution, the "mobile revolution". These platforms, which are carried on mobile devices, create what is known as data exhaust, the metadata generated as a by-product of people's online actions. When mined, this data exhaust reveals massive amounts of new information about consumers, their behaviour and their livelihoods. This type of data accounts for most of the big data available.

Consequently, data mined from mobile phones is said to be at the heart of Uganda's big data phenomenon. Mobile data provides the granularity that development partners hope to obtain from census data – it is available in near real time. Mobile data can provide insights, for instance, into migration patterns and the associated public health concerns, and into the trade and economic implications of financial inclusion, two sectors that are key for sustainable development. This kind of data is starting to become critical for developing countries that do not have sophisticated national statistics collection methods or usable data for monitoring and development reporting.

1.4   Uganda government efforts to promote big data adoption

The Government of Uganda has embarked on a number of interventions to promote big data adoption in the country. The initiatives are described below.

Firstly, the Government has developed the Big Data Utilization Strategy to guide implementation of the country's big data projects. The strategy has six pillars aimed at addressing the key big data utilization challenges of limited access to and sharing of data; limited access to infrastructure; poor culture of data utilization; limited trust among data consumers and data suppliers; and a critical lack of skilled big data analysts/scientists.

In addition, laws, standards and regulations relating to data collection, security, sharing and archiving have been developed and enacted. These include the Data Protection and Privacy Act 2019, the Access to Electronic Data Act 2005 and the Archival Act, and are intended to boost data accessibility, which is a big data analytics facilitating factor.

Thanks to World Bank funding, the Government of Uganda has put in place the Enterprise Architecture and Interoperability Framework, to enable all government agencies to design their data architecture in a way that enhances data sharing. It has invested in the national backbone infrastructure to improve Internet connectivity, which in turn promotes the growth of the big data ecosystem. It has established a national data centre for public sector entities, NITA-U.

The government-owned Makerere University Kampala, Mbarara University of Science and Technology and Busitema University have opened artificial intelligence laboratories to carry out research and implement big data pilot projects. In addition, Makerere University Kampala and the Uganda Institute of Information Communication and Technology have introduced short data science courses, at the undergraduate and graduate levels, to build big data skills.

Under the Digital Uganda Vision, the Government seeks to enable citizens to reap the benefits of technology by creating an enabling environment for the private sector to do business while improving the efficiency and effectiveness of public administration and services.

The above interventions show the extent of the Government's ambitions in terms of big data utilization, but impediments remain in the way it collects, analyses and uses data, especially big data analytics. One of the major challenges here is the lack of skilled public sector personnel with expertise in big data analytics. There is also limited investment in infrastructure, research and development to support the growth of the big data ecosystem.

1.5   Big Data Utilization Strategy (2023–2027)

With support from key stakeholders, the Government of Uganda launched the Big Data Utilization Strategy in September 2023. The strategy is a guiding framework enabling the country to harness the power of data, big data in particular, and to make data-driven decisions to achieve social, economic and environmental goals.

The Big Data Utilization Strategy has six pillars:

1)   Data foundations and governance.
2)   Data literacy and skills.
3)   Data security, privacy and responsibility.
4)   Data access, integration and availability.
5)   Data services and innovation.
6)   Data sovereignty and equality.

The strategy's implementation will enable the Government to start exploiting the potential of the big data being generated and to make data-driven decisions that will catalyse the building of Uganda's digital society.

1.6   Objective of the consultancy

The consultancy's main purpose was to conduct a baseline assessment of the big data landscape in Uganda. It also assessed the competencies of relevant public sector staff to apply big data. These assessments were done to determine the status of big data utilization in the country and to come up with a training curriculum to develop big data analytic skills, respectively. Ultimately, the aim is to enhance the Government's service delivery based on big data analysis.

The specific objectives of the assessment were to:

a)   Conduct a baseline assessment of the big data landscape among relevant public and selected private sector entities;
b)   Analyse the stakeholders in Uganda's big data ecosystem;

c) Assess the capacity of public sector officials to use big data;

d) Make recommendations for improving big data quality, as appropriate.

1.7 Scope of the assessment

The assessment covered all relevant entities/organizations engaged in the (potential) adoption and use of big data. It covered stakeholders in the promotion, implementation and service delivery of big data analytics, including relevant public sector ministries, departments and agencies. It also covered relevant development partners, educational institutions and private sector enterprises. The overall scope of the assessment included:

a) A review of the country's big data landscape, which entailed assessing the maturity/ extent to which relevant organizations or entities had developed or implemented big data and made recommendations from which a big data implementation framework was developed. Benchmark reviews were also done with countries that have a well-developed big data landscape, to make recommendations that will contribute to the development of the big data implementation framework.

b) A capacity needs assessment of relevant public sector staff, to determine gaps in the skill set needed to use big data infrastructure and apply big data analytics. The aim was to develop and recommend a foundational and practical training programme for the IT and statistics cadres from selected public sector entities in Uganda.

2 Methodology

2.1 Assessment design

Uganda's big data landscape was assessed using a cross-sectional mixed method involving both descriptive and analytical analyses and employing rapid participatory methods. The quantitative component involved the collection of primary data from several organizations/entities using semi-structured questionnaires. Desk reviews were conducted of the primary analysis of relevant data and information. The assessment also had a qualitative component involving key informant interviews with national policy-makers, selected government ministries, departments and agencies, and private sector entities. The staff of relevant development partners involved in the digitalization and promotion of data utilization were also interviewed.

Figure 1: Assessment stages

Summary of the Assessment Criteria

Baseline assessment

Stakeholder analysis

Big data competency assessment

Implementation strategy and framework

Provide recommendations
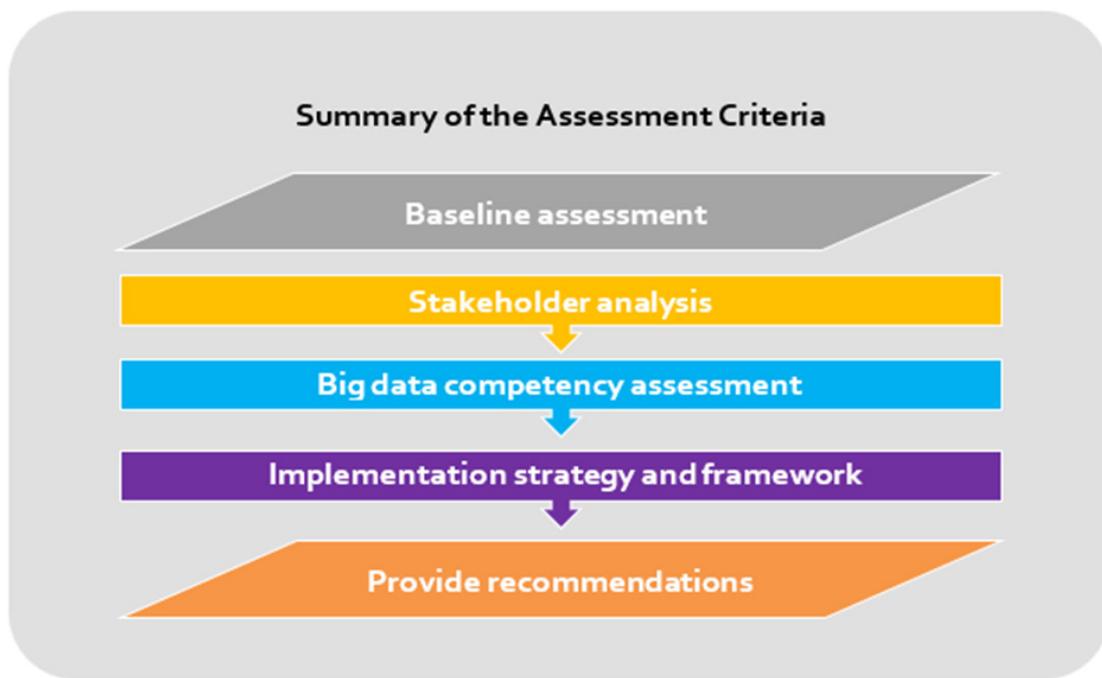
As shown in Figure 1 above, the assessment comprised five stages. The first two stages involved a baseline landscape assessment and a stakeholder analysis. The next stage involved conducting a training/competency needs assessment of IT and statistical cadres at the public sector entities. The last two stages involved developing an implementation framework based on recommendations. These stages were covered as shown the assignment work-plan detailed in Annex 1.

The approaches detailed in Table 2 below were used to undertake activities aimed at assessing the big data landscape and big data-related competencies of relevant public sector staff in Uganda.

Table 2: Overall implementation review assessment matrix

Activity	Subactivities	Proposed methodology		
		Desk review	Key informant interviews and self-assessment by public sector staff	Key informant interviews with private sector entities, NGOs and development partners
Conduct a comprehensive big data baseline assessment to identify critical gaps hindering the creation of a digital and big data economy	Review any existing big data policies, sources, use cases, infrastructure and initiatives	✓	✓	✓
	Identify gaps and needs in big data infrastructure, including data centres and storage facilities	✓	✓	✓
	Conduct benchmark studies against selected economies that have registered success in building a big data economy	✓		✓
	Conduct a big data maturity assessment of relevant entities	✓	✓	✓
Perform a thorough stakeholder mapping exercise and facilitate consultations	Identify and profile major participants in the big data sector across Uganda	✓	✓	✓
	Participate in and facilitate stakeholder engagement sessions to collaboratively develop guiding strategies	✓		✓
Assess the training needs of public officials	Analyse public official and policy-maker training needs, to guide the design of the big data training programme		✓	✓
	Design targeted capacity-building programmes to foster the skills necessary for the initiative's sustainability	✓		✓

Table 2: Overall implementation review assessment matrix (continued)

Activity	Subactivities	Proposed methodology		
		Desk review	Key informant interviews with and self-assessment by public sector staff	Key informant interviews with private sector entities, NGOs and development partners
Develop a big data implementation strategy/framework and related recommendations	Draw on insights from benchmarking exercises to determine best practices for big data development	√	√	√
	Conduct a review of the legal and regulatory framework affecting big data and make recommendations	√	√	
	Develop a comprehensive framework to guide the implementation of Uganda's big data strategy	√	√	√

2.2 Data collection methods

2.2.1 Desk reviews

Secondary information was reviewed to support the assessment of the big data landscape in Uganda. It was fortunate that some work had been done by the Ministry of ICT and National Guidance during the development of the Big Data Utilization Strategy. Also, draft documentation and validation meetings related to ongoing discussion of the draft National Data Strategy were reviewed and participated in, respectively. In addition, information was reviewed from performance reports and strategic plans drawn up by government ministries/agencies and selected private sector players using (or in the process of introducing) big data analytics. The following documents were consulted as part of the secondary data analysis:

- The Big Data Utilization Strategy
- The draft National Data Strategy
- The Digital Uganda Vision
- The strategic and investment plans of relevant government ministries/agencies and relevant private sector players
- Annual performance reports for relevant government ministries/agencies and relevant private sector players
- GovTech Maturity Index Reports
- ITU Global ICT Development Index and ITU Data Hub statistics
- The Inclusive Digital Economy Scorecard
- Recent research reports concerning big data adoption in Uganda.

The above reports provided detailed information and datasets to support the assessment of the big data landscape in Uganda.

2.2.2 Key informant interviews

To gain a comprehensive understanding of the context and environment in which big data is (or is not) being adopted and used in the country, self-assessments and key informant interviews were undertaken with national stakeholders in Uganda's big data ecosystem. The stakeholders were identified by looking at the participants in the development of the Big Data Utilization Strategy, conducting a rapid stakeholder scoping exercise together with the Ministry of ICT and National Guidance and the Uganda Bureau of Statistics, and consulting with the ITU big data expert team working on the project that commissioned this assessment. The expert consultations of stakeholders that developed the strategy revealed that, in addition to the public sector entities identified, it would be beneficial to assess the telecommunication industry and the financial services sector, which were the only sectors in the private sector where institutional big data adoption had been promoted and might be occurring. The list established at the outset was not exhaustive but did lead to the identification of other entities that plan to or already use big data in the country. These entities were as a result also approached and interviewed (see Table 3 for the list of entities interviewed).

At the national level, initial interviews were held with key public sector ICT and/or statistics staff. Thirteen out of the country's 21 key ministries were assessed (61.9 per cent response rate). In addition, 10 ministry departments and government agencies responded to the assessment.

The public sector entities that responded included ministries and government agencies. The following ministries were interviewed: Finance and Economic Development; Trade, Industries and Cooperatives; Health; Works and Transport; Agriculture, Animal Industries and Fisheries; Education and Sports; Lands, Housing and Urban Development; Tourism, Wildlife and Antiquities; Science, Technology and Innovation; Internal Affairs; Water and Environment; and Public Service. The following government agencies were also interviewed: the Uganda Bureau of Statistics; NITA-U; the Public Procurement and Disposal of Public Assets Authority; the UCC; the Uganda Revenue Authority; the Civil Aviation Authority; and the National Planning Authority. Other government entities interviewed were the National Identification and Registration Authority, the Uganda National Meteorological Authority and the Uganda Registration Services Bureau.

People were also interviewed at educational institutions identified as having the potential to provide data science courses related to big data: Makerere University Kampala, Mbarara University of Science and Technology, the Uganda Institute of Communications and Technology, Uganda Martyrs University, Refactory Uganda and ISBAT University.

Selected private sector players were also interviewed. Given that both expert opinion and the Big Data Utilization Strategy considered that big data adoption was prevalent in the telecommunication and banking/financial sectors, the interviews focused on those sectors. Staff at major telecommunication companies (MTN, Airtel and Uganda Telecom) were interviewed. Owing to the shortage of time and resources, the private financial services sector was subject to secondary data analysis and review. Development partners supporting the big data adoption and use programmes were also interviewed (e.g. UNDP and UN Global Pulse – Kampala). In addition, staff from the UN Regional Hub on Big Data and Data Science for Africa, the African Centre for Statistics of the United Nations Economic Commission for Africa, Belgium's Enabel and Germany's GIZ were interviewed.

Before the key informant interviews, staff in the categories of interviewees selected, save for the educational institutions and technology service providers, received and answered structured self-assessment tools.

In all, 38 key informant interviews were conducted at national level. Relevant staff working in the IT and statistics sections of the selected entities were interviewed at the national level. The key informant guide and self-assessment tools (stakeholder scoping, competency assessment tool and maturity matrix assessment tool) were developed and deployed. They are attached as Annexes 2, 3, and 4 to this report.

Table 3: Key informants interviewed

Level	Persons	Total
National (policy and oversight, implementation stakeholders for big data)	• IT/statistics focal points at 10 Government agencies (Uganda Bureau of Statistics, UCC, Uganda Revenue Authority, Public Procurement and Disposal of Public Assets Authority, NITA-U, Civil Aviation Authority, Uganda Registration Services Bureau, National Identification and Registration Authority, Uganda National Meteorological Authority, National Planning Authority • IT/statistics focal points at the 13 government ministries initially identified as having potential big data-related initiatives (Finance and Economic Development; Trade, Industries and Cooperatives; Health; Works and Transport; Agriculture, Animal Industries and Fisheries; Education and Sports; Lands, Housing and Urban Development; Tourism and Antiquities; Science, Technology and Innovation; Internal Affairs; Water and Environment; Public Service • Focal points at five development partners (UN Global Pulse, Enabel, UN-CEBD Regional Hub for Africa, GIZ and UNDP) supporting big data adoption and usage • Representatives of the three main telecommunication companies (MTN, Airtel and Uganda Telecom) • Heads of seven university colleges/schools teaching data science-related courses (Makerere University Kampala, Uganda Institute of Communications and Technology, Uganda Martyrs University, Mountains of the Moon University, ISBAT University, Mbarara University of Science and Technology, Refactory)	38

2.2.3   The big data maturity matrix self-assessment

The big data maturity matrix assessment model used in this assessment was developed by the GWG. The model helps public sector organizations measure, improve and maintain the health and strength of their big data ecosystems. It has been adopted widely because of its completeness in terms of big data adoption and utilization. The model was contextualized to Uganda's current setting based on guidance from the Ministry of ICT and National Guidance and ITU big data experts. The maturity self-assessments were used to gauge the status of the various public and private sector organizations targeted in terms of their adoption and use of big data analytics.

The big data maturity assessment has four maturity levels: pre-foundation, foundation, practitioner and expert (see Table 4). It can be used to identify areas within an organization where investment in big data initiatives is most needed. It should be noted that the pre-foundation maturity level was slightly modified to include entities that had not yet begun their journey towards adoption of big data analytics. This was the only tweak to the original maturity levels as created by the GWG and was agreed at the start of the assessment.

Table 4: Summary description of big data maturity levels

Level of maturity	Description
Pre-foundation	This level typically describes an organization that is at the start of its big data journey, one that is considering how to commence big data projects and the strategies it will need to put in place to make them happen. This level was contextualized to cover entities that had yet to begin or were just thinking about adopting big data.
Foundation	This describes the next level of development, where big data leadership, strategies and frameworks are being developed and a small number of big data projects are under way.
Practitioner	The next level of development describes an organization where the appropriate frameworks have been established, data scientists have been hired and big data projects are under way and being managed in a strategically coordinated way.
Expert	This is the most mature level of development. Here, big data/data science is well embedded and data science is extensively applied within the organization. Staff have the knowledge, skills and experience to lead and undertake big data projects within and across teams. Training, coaching and mentoring are available internally and may be offered externally to other organizations.

The big data maturity assessment also has four themes – legal and policy frameworks; IT infrastructure; human resources; application of big data analytics – and 23 subthemes (see Table 5; more detailed information on the subthemes is provided in Annex 4).

Table 5: Summary description of themes and subthemes for big data maturity assessment

Theme	Subthemes/topics
Legal and policy frameworks	1. Status of policies/guidance for handling big data
	2. Organization's adherence to policy/guidelines
	3. Legal considerations for disclosure of data
	4. Partnership and agreement practices
	5. Intellectual property and copyrights
Information technology infrastructure	6. Computing power and data hosting
	7. Processes and tools used in big data
	8. Security of data import and export processes
	9. Accessibility to big data and related applications
	10. Data governance practices

Table 5: Summary description of themes and subthemes for big data maturity assessment (continued)

Theme	Subthemes/topics
Human resources	11. Awareness of big data sources
	12. Organizational structure relating to big data/data science posts
	13. Organizational big data/data science skills
	14. Acquisition of big data/data science expertise for project delivery
	15. Availability of big data/data science training courses
	16. Big data/data science recruitment processes
Application of big data analytics	17. Who carries out big data tasks or projects
	18. How big data tasks/projects are carried out
	19. Procedures developed for acquiring, processing and sharing big data
	20. Big data solutions in statistical production processes
	21. Integration of big data project results in the organization's resources
	22. Dissemination of big data research results
	23. Information-sharing between big data projects within or outside the organization

2.3   Implementation framework development and validation meeting

Once the results obtained from the above data-collection processes had been synthesized, recommendations were made. These recommendations were used to develop an implementation framework for the proposed big data development project and were discussed and validated at National Data Strategy meetings organized by the Ministry of ICT and National Guidance, UNDP and UN Global Pulse. Application use cases based on the benchmarking reviews were also proposed. The next steps will be to build consensus on the recommendations and obtain input from stakeholders on the implementation framework. A participatory and consultative process involving the stakeholders was used to review the implementation framework. The Big Data Utilization Strategy was referred to and reviewed during the National Data Strategy meetings, at which many implementation activities for big data utilization were discussed.

A review of both strategies (Big Data Utilization Strategy and National Data Strategy) revealed some similarities. The proposed Big Data Utilization Strategy implementation framework was also modeled around six similar and related pillars: data foundations and governance; data literacy and skills; data security, privacy and responsibility; data access, integration and availability; data services and innovation; and data sovereignty and equality. The strategy being developed touched on all six pillars. The proposed implementation plan and the corresponding monitoring and evaluation framework are being developed along these six pillars.

3   Key findings

3.1   General characteristics of public sector entities on big data analytics

3.1.1   Types of organization assessed

At the outset, government ministries and agencies were identified with the help of the Ministry of ICT big data team, the ITU big data expert team and development agencies like UNDP. Specifically, 13 government ministries and 10 government agencies took part in the assessment (see Figure 2). They were selected based on a rapid stakeholder analysis, desk reviews, participation in the development of the Big Data Utilization Strategy, benchmarks from other countries and potential use cases.

Figure 2: Proportion of participating public sector entities, by type
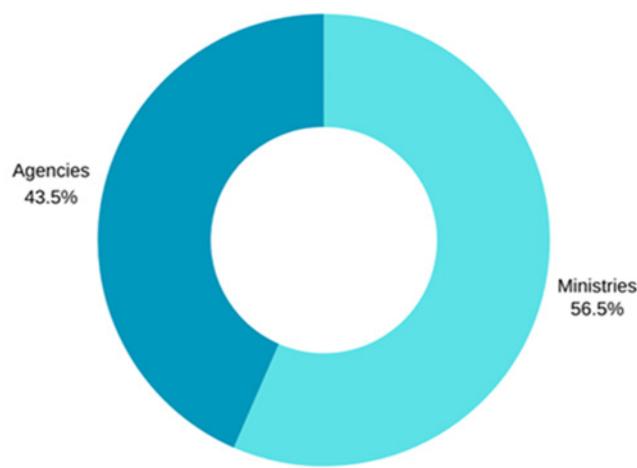
Source: Assessment of Uganda's big data landscape, 2024.

In addition, three major telecommunication companies – non-State actors – were interviewed. A secondary analysis was conducted using a recent assessment of 34 financial institutions, from whom results had been obtained to back up interviews with two big commercial banks. Most of these are private sector actors, with only one telecommunication company and one bank being government-owned. Details of the responses are given in Annex 10 to this report.

3.1.2   Knowledge of big data among public sector entities

The majority of respondents – IT officers and statisticians at the public sector entities –reported that they knew what big data was: 82.6 per cent of IT officers and statisticians at the public sector entities assessed reported that they knew what big data was and 17.4 per cent that they knew something about big data (see Figure 3). No one claimed complete ignorance. However, the interviews revealed that the interviewees had different definitions of big data. Several considered volume to be the only characteristic of big data, which is not the case.

Figure 3: Proportion of public sector employees, by familiarity with big data

Somewhat
17.4%

Yes
82.6%
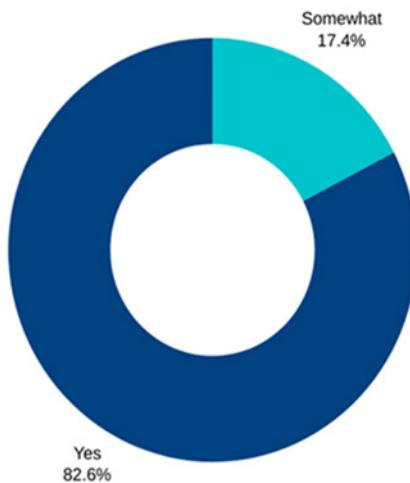
Source: Assessment of Uganda's big data landscape, 2024.

3.2   Legal and policy framework

3.2.1   Quantitative analysis of the legal and policy big data maturity level of public sector entities

An analysis of the data collected from the public sector entities assessed revealed that the majority (60.9 per cent) were at the pre-foundation maturity level, meaning that they had no legal framework for access to and sharing of non-traditional/big data or were only starting to consider the requirements for and development of such a framework. Some of these entities had started to discuss disclosure control policies, sanctions for misuse and data acquisition powers. A further 14 per cent were at the foundation maturity level, meaning that they had no policies in place but had started work to develop policy documents outlining how data, including big data, should be disclosed. A few of the government ministries and agencies (e.g. Ministry of Tourism and Uganda Bureau of Statistics) self-assessed themselves at the practitioner and expert maturity levels. These results are summarized in Figure 4 below.

Figure 4: Proportion of public sector entities, by legal and policy maturity level

Practitioner
8.7%

Expert
4.3%

Foundation
26.1%
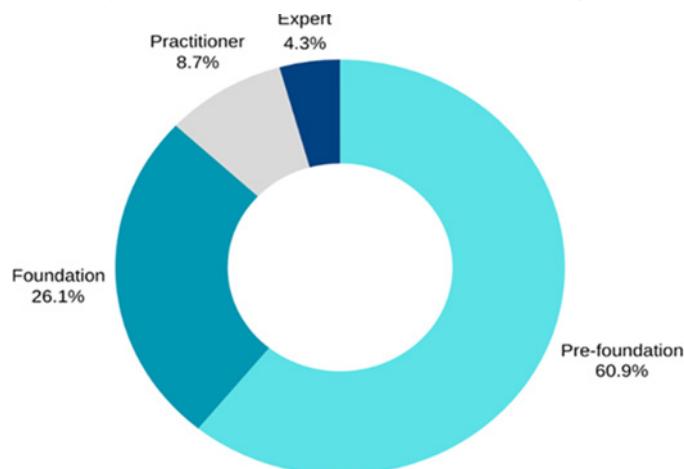
Pre-foundation
60.9%

Source: Assessment of Uganda's big data landscape, 2024.

In addition, the majority (57%) of the public sector entities assessed were at the pre-foundation level for two of the five subthemes (see Figure 5). In terms of the status of policies for handling big data sources, 57 per cent did not have internal policies or guidelines adequately describing how big/non-traditional data should be shared, used and disclosed, and only 4 per cent had a policy stipulating sanctions for violations, qualifying them for the expert maturity level. In terms of adherence to policies and guidelines, at 57 per cent of the public sector entities assessed, current policies/sanctions did not adequately address the misuse of big data. In addition, the majority (87%) had not begun to discuss adherence to intellectual property and copyright requirements for big data and 50 per cent allowed third parties to share data with the organization. Sharing agreements were recorded and linked to existing data, including potential non-traditional and/or big datasets.

Figure 5: Proportion of public sector entities, by legal and policy maturity subthemes
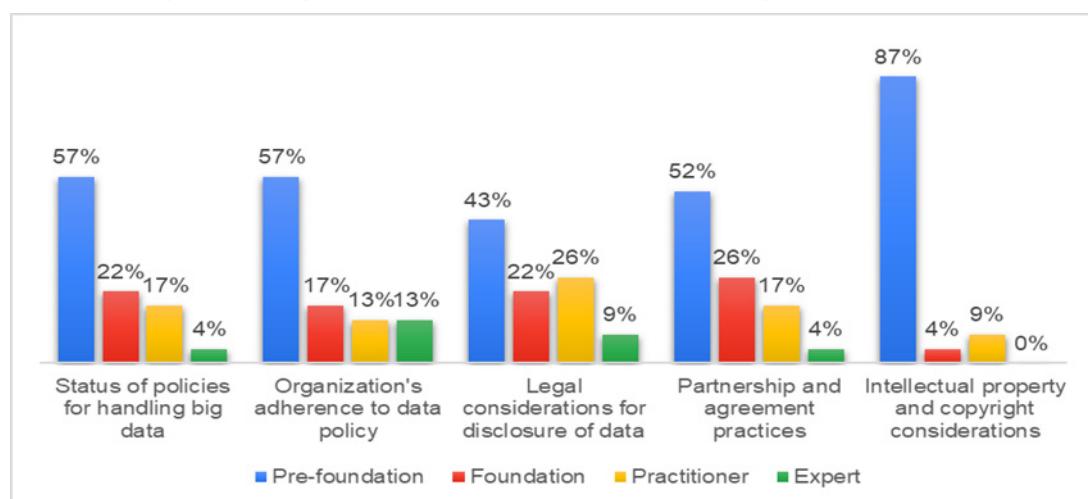
Source: Assessment of Uganda's big data landscape, 2024.

3.2.2   Qualitative analysis of the legal and policy frameworks affecting big data

The qualitative analysis summed up below is based on a review of the literature and unstructured responses from the interviewees. Uganda has adopted laws, standards and regulations relating to data security, collection, sharing, archiving and use (including big data). Examples are the Access to Information Act, the Electronic Transactions Act, the Archival Act, National Data Bank regulations, the Government of Uganda Social Media Guide, and the Data Protection and Privacy Act. The way that these frameworks have been developed and structured affects the implementation of various data management projects, including big data projects, across the public and private domains, and interconnectivity with the external environment (regionally and globally). Compliance with legal requirements is essential for the development and implementation of big data projects.

Table 6 outlines some of the strengths and weaknesses of key acts related to big data use.

Table 6: Summary description, strengths and weaknesses of selected data-related laws

Act	What it's about	Strengths	Weaknesses
Access to Information Act 2005	This act provides for the right of access to information held by public bodies and private entities performing public functions. It promotes transparency and accountability in government and public institutions.	The act has been used to obtain information on government expenditure, which has helped to promote transparency and accountability in government. The act enables the public to access and participate in decisions that affect them as citizens. The act provides a legal framework for the protection of the right to access information in Uganda. The act is essential to human rights, providing citizens with legal access to government-held information that directly impacts them.	The act has been criticized for its weak enforcement mechanisms and limited scope. This has limited its impact. The act does not provide clear guidelines on the enforcement of the right to access information, which could lead to inconsistent application of the law. The act does not contain clear guidelines on the penalties for non-compliance with the right to access information, which could lead to inadequate deterrence of violations. The act does not provide clear guidelines on the classes of information that are exempt from the right to access information, which could lead to disputes over the release of certain information. The bodies required to disseminate information are limited and no provision is made for the delayed release of information. The act does not necessarily guarantee freedom of information.

Table 6: Summary description, strengths and weaknesses of selected data-related laws (continued)

Act	What it's about	Strengths	Weaknesses
Electronic Transactions Act 2011	This act provides for the legal recognition of electronic transactions and electronic signatures. It also establishes the legal framework for electronic records and communication.	The act has been praised for its role in promoting e-commerce and digital innovation in Uganda. The act encourages the use of e-government services and provides for the recognition of electronic signatures, records and agents. The act also stipulates that electronic records are admissible as evidence in legal proceedings.	The act has been criticized for its lack of clarity on certain issues, such as the admissibility of electronic evidence in court. The act does not contain extensive provisions on privacy and data collection, usage, retention and protection mechanisms. The act does not regulate electronic payment systems or electronic contracts.

Table 6: Summary description, strengths and weaknesses of selected data-related laws (continued)

Act	What it's about	Strengths	Weaknesses
Data Protection and Privacy Act 2019	This act regulates data protection and privacy activities in Uganda. It outlines various principles concerning data protection.	The act provides a legal framework for the protection of personal data in Uganda. It thus helps to safeguard the privacy of individuals and promote trust in e-government and e-commerce services. The act also establishes the rights of data subjects, which include the right to access, correct and delete their personal data. The act requires data controllers and processors to obtain consent from data subjects before collecting, processing or using their personal data	The act has some loopholes, such as weak enforcement and implementation mechanisms. Few interviewees were aware of the act specifically. Information about the act is not disseminated among relevant organizations the way it is in the European Union. The act does not provide clear guidelines on the enforcement of data protection regulations, which could lead to inconsistent application of the law. The act does not provide clear guidelines on the penalties for non-compliance with data protection regulations, which could lead to inadequate deterrence of data breaches. The act does not provide clear guidelines on the transfer of personal data outside Uganda, which could lead to inadequate protection of personal data.

According to the report entitled *Situation Analysis of Uganda's Internal and External Data Ecosystem, 2024* (Waema, Rukundo and Mugerwa, 2024), the laws/acts were generally well developed. The issue of inadequate regulations for non-personal data – a glaring gap in the regulatory environment – is one of the biggest weaknesses identified. According to the report entitled *Vulnerability and resilience: How does Uganda's data ecosystem inform social protection systems?* (Development Initiatives, 2024), Uganda lacks clear policies and procedures for sharing data responsibly, stoking concerns about violations of privacy regulations and/or exposure of sensitive information and preventing many public sector entities and private sector organizations from freely sharing data.

Learning from big data-savvy countries like Estonia and India that have governance mechanisms for non-personal data, it is equally important to have regulations addressing non-personal data privacy and protection concerns in order to achieve the objectives of the Big Data Utilization Strategy. Annex 6 provides further information on the big data-related legal and policy provisions needed in the country.

In conclusion, and overall, the quantitative and qualitative findings tally: Uganda's current data protection laws and regulations can negatively impact its big data ecosystem. For instance, the lack of comprehensive data protection laws could lead to data breaches and misuse of personal data. Data privacy laws may impact the collection and processing of personal data. The lack of a comprehensive data governance regulatory framework, including enforcement, limits the country's ability to reap the full benefits of data, especially big data. This could negatively impact the big data ecosystem if not dealt with at this generally nascent stage.

3.3   Information technology infrastructure

3.3.1   Quantitative analysis of the IT infrastructure big data maturity level of public sector entities

According to Figure 6 below, a descriptive analysis of the data collected from the public sector entities assessed reveals that most (73.9 per cent) are at the pre-foundation big data maturity level. This means that most have not yet considered or are starting to consider investing in the required IT infrastructure. They do not yet have dedicated big data infrastructure (or access to it if it is external to the organization) for working with non-traditional/big data sources. A further 17.4 per cent and 8.7 per cent of the public sector entities are at the foundation and practitioner maturity levels, respectively. Computing power and storage are limited. There are no data security measures in place for the import/export of big data and the data are not widely accessible to all within the organization.

Figure 6: Proportion of public sector entities, by IT infrastructure big data maturity level

Practitioner
8.7%

Foundation
17.4%

Pre-foundation
73.9%
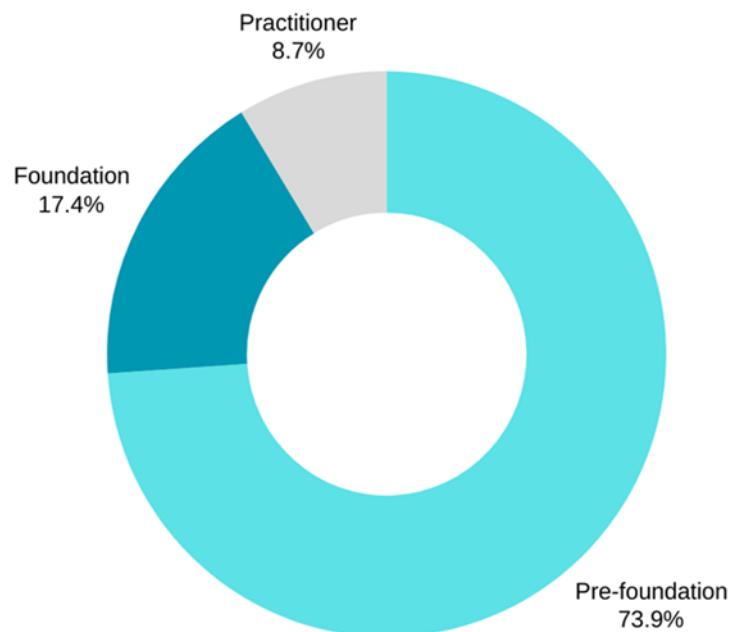
Source: Assessment of Uganda's big data landscape, 2024.

Among the private sector actors assessed, two of the three main telecommunication companies and some commercial banks were at practitioner maturity level in terms of IT infrastructure. The two telecommunication companies reported that they had dedicated big data infrastructure with no limits to the size or complexity of the data; they also had agreements covering access to external IT infrastructure. Processes and tools had been created once for multiple use across the organization. Both had a fully-fledged big data infrastructure. A secondary analysis of data collected from financial institutions revealed that 23 per cent reported that they, too, had the necessary big data infrastructure. For example, the Central Technology Services arm of Centenary Bank reported that they were at practitioner level.

The assessment also analysed the maturity level of the IT infrastructure subtheme. On average (see Figure 7), about 70 per cent of the public sector entities assessed were at the pre-foundation stage for all five IT infrastructure subthemes. Further, 74 per cent were at the pre-foundation stage in terms of big data computing power and data hosting, meaning that they had no big data projects as yet or that their projects did not have dedicated infrastructure and instead relied on insufficient existing resources. The lack of dedicated resources severely affected big data computing power and storage capacity. None of the public sector entities had dedicated big data IT infrastructure designed to scale increasingly complex projects and functioning as an integral part of their IT operations. Infrastructure deployment and computer resource provisioning could be automated. In the majority of the public sector entities, only IT staff could access data and applications or data analysts could access the data on an ad hoc basis. A further 27 per cent of the public sector entities had some computing power and data hosting access. The public sector entities had no specific big data deployment processes or tools as yet. They mainly stored their largely structured data in an existing data warehouse, where most operations were performed manually. Seventy-four per cent did not have access to big data-related applications and only 26 per cent had some access to big data infrastructure applications. The entities concerned attributed their inability to access big data tools to the high costs of infrastructure.

Figure 7: Proportion of public sector entities, by IT infrastructure big data maturity subtheme
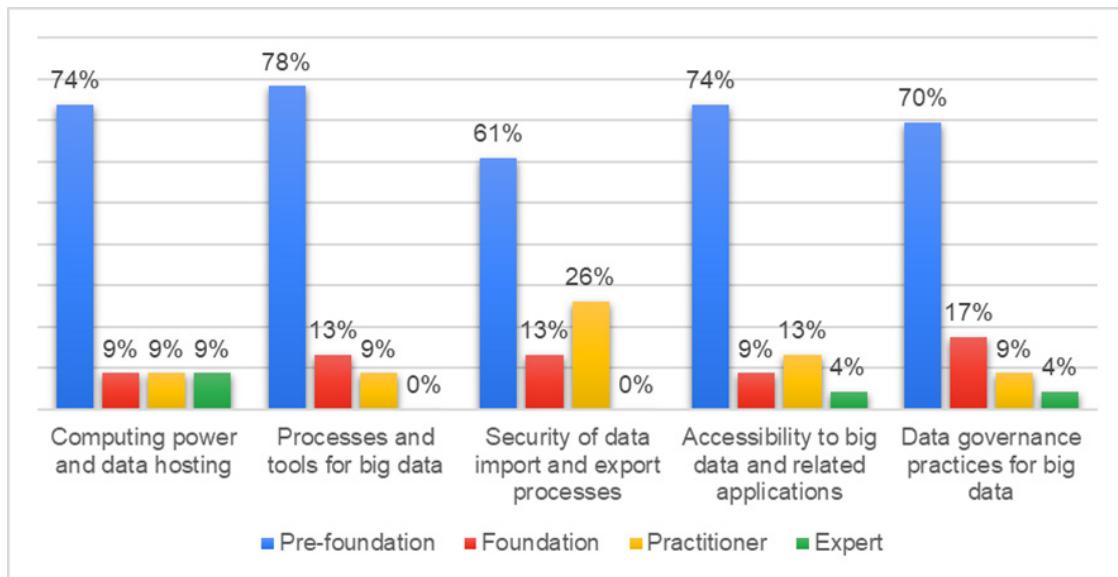
Source: Assessment of Uganda's big data landscape, 2024.

3.3.2 Qualitative analysis of the IT infrastructure big data maturity level of public sector entities

According to the Big Data Utilization Strategy (2023-2027), data infrastructure and technology in Uganda remains in the early stages of development. This is especially true for big data IT infrastructure. The Government has made an effort to enable public sector entities to design their own data architecture with the support of development partners. This can be seen, for example, at the Ministries of Health and of Tourism and Antiquities. In some instances, the Government has embarked on these projects on its own; the Ministry of Education and Sports, for instance, reports that the Government has hired external consultancy firms to develop the Education Management Information System, with support from the Ministry of ICT and National Guidance.

According to the report entitled *Situation Analysis of Uganda's Internal and External Data Ecosystem, 2024* (Waema, Rukundo and Mugerwa, 2024), Uganda's data infrastructure is composed pre-eminently of data centres, data networks and cloud services. The Government is investing in the expansion of the national backbone infrastructure, which will improve Internet connectivity and support the growth of the big data ecosystem.

Data centres: The Government and private companies, in particular telecommunication companies, have built data centres. Whereas the NITA-U National Data Centre provides the public sector with storage and data-processing facilities, various public sector entities have instead installed their own management information systems, supported by their own data warehouses and especially at sector level (for instance, parish development model, agriculture, health, water, education, road network). However, whether public or private, these are fragmented efforts to set up data centres for the collection, storage and real-time processing of data (often tailored to fit for purpose).

With permission and access, the data centres assessed in the country can be configured to collect, store and analyse big data, meaning that any public sector big data pilot projects can

use the centre. The Uganda Bureau of Statistics is planning to establish a national data science laboratory in the next five years.

Data networks: Through NITA-U, the Government has been boosting the capacities of public sector entities to set up data networks. One such endeavour is the establishment, with World Bank support, of the National Enterprise Architecture and Interoperability Framework. The framework enables all government agencies to design their data architecture with a view to efficient and secure sharing of data. One of the main challenges is that high-speed Internet connectivity, which is critical for the processing and analysis of large amounts of data, including big data, is unavailable in most parts of the country.

Cloud computing and related services: In October 2018, NITA-U launched the National Cloud Computing Guidelines for Government, Ministries, Departments and Agencies. The rationale for these guidelines was to increase the use of cloud services and thereby alleviate the current state of infrastructure silos, reduce risks and shift the focus to IT services as a utility. In the long term, they will eliminate duplication, reduce risk exposure, and enhance information-sharing and the interoperability of e-government applications.

Since the launch of the guidelines, cloud services have allowed the Government to provide a more interoperable hosting environment for data and systems, and to introduce common services built on shared infrastructure and economies of scale. The Government, working with the private sector, is also investing in data centres and cloud computing solutions to support the growth of the ecosystem, especially for big companies, businesses and NGOs.

Figure 8: Cloud computing and other related services at public sector entities
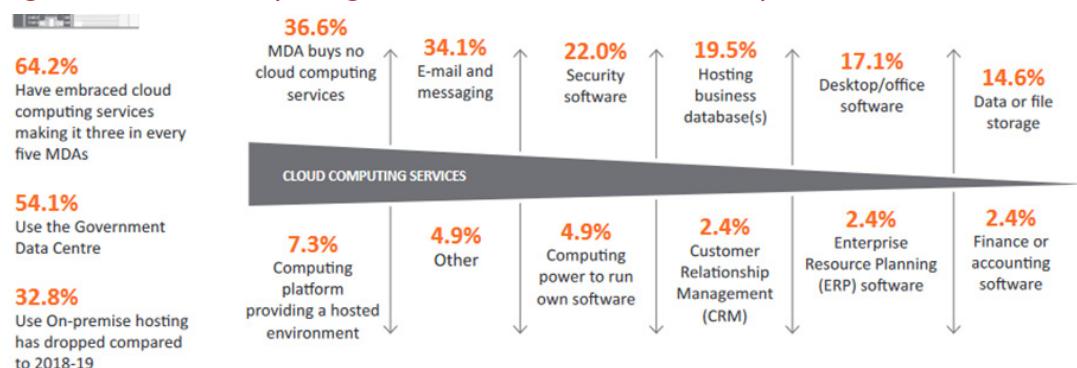
Source: NITA-U 2022.

However, Waema, Rukundo and Mugerwa (2024) noted in their 2024 report that cloud services are minimally used and that there is limited capacity for installation and use. This tallies with the results of the 2022 national IT survey (NITA-U, 2022), which reported that only 32.8 per cent of public sector entities had in-house data hosting infrastructure, 36.6 per cent did not buy cloud computing services, and 64.2 per cent had embraced cloud computing services (see Figure 8). In the third category, 54.1 per cent used the government data centre housed at NITA-U. There were two main reasons why public sector entities were not using cloud computing services: the high cost and security concerns.

Technology for data management, analytics and reporting: According to the national IT survey (NITA-U, 2022), the penetration rate for IT technologies and devices among public sector entities was relatively high when it came to desktop computers, laptops and printers (97.9 per cent), projectors (89.5 per cent) and LCD TVs (86.3 per cent); it was low for fax machines (15.8 per

cent), barcode readers (16.8 per cent) and smart boards (22.1 per cent). The status of big data source technologies was as follows: mobile phones – 41 per cent; fingerprint readers – 46.3 per cent; VoIP phones – 47.4 per cent; network cameras – 87.5 per cent; desktop computers – 97.8 per cent; and tablets – 54.7 per cent. The data were collected and monitored using cookies (from website content) or image data harvested from the devices (see Figure 9).

To standardize the technology for data management, analytics and reporting, NITA-U has been streamlining the portfolio for all government systems for data management analytics and reporting (see Annex 7), which shows that a range of data management systems are used across government agencies; interconnectivity for comprehensive analysis and national synthesis is limited and their holistic use thereby curtailed.

Figure 9: IT systems and devices at public sector entities
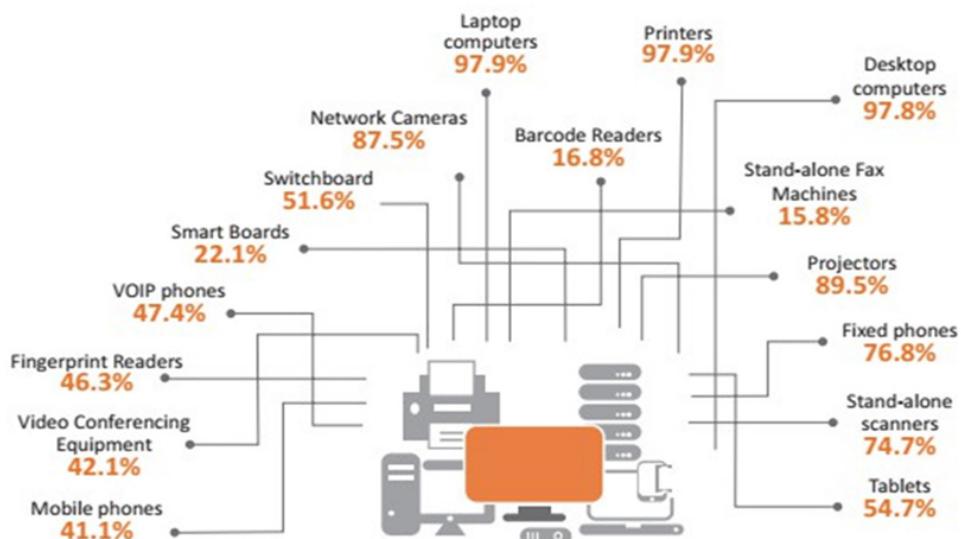
Source: NITA-U, 2022.

Key data and IT status for Uganda

According to the report entitled *Situation Analysis of Uganda's Internal and External Data Ecosystem, 2024* (Waema, Rukundo and Mugerwa, 2024), Uganda has made significant improvements since 2000 on most performance indicators for IT penetration. Figure 10 summarizes the categories of indicator, including level of access to Internet services, use of computers, databases maintained, proportion of public sector entities with ICT staff, and public sector entities that have experienced IT security incidents.

Specifically, 59 per cent of public sector entities offered digital or online services to the public. Compared to 2018 (base period as seen in Table 1 above), when 20 per cent of public sector entities were offering online services to the public, this means that the potential for public sector entities to access varying data sources electronically is growing. In addition, 42.1 per cent of public sector entities maintained databases for public data information; 64.2 per cent had embraced cloud computing services, with 32.3 per cent having their applications or systems in cloud servers; and 2.2 per cent of government cadres in the public sector entities were IT officers. All the public sector entities had institutional access to the Internet, mainly through the coordinating efforts of NITA-U and the Ministry of ICT and National Guidance.

Figure 10: Key data and IT indicators across public sector entities

64.7%
Proportion of total persons employed in government MDAs routinely using internet

100%
Proportion of government MDAs with institutional Internet access

81.1%
Proportion of government MDAs providing Internet access to employees using Institution-wireless networks

76.8%
Proportion of government MDAs with an IT service/help desk

44.2%
Proportion of government MDAs with an Intranet

60.5%
Proportion of employees in government MDAs routinely using computers

59.9%
Of MDAs had experienced some type of IT Security incident

2.2%
Proportion of employees in government MDAs are ICT staff

42.1%
MDAs maintained databases for public data information

94.7%
Proportion of government MDAs with institutional email

97.9%
Proportion of government MDAs with a Web presence (web site)

59%
of MDAS offered digital or online services to the public &/or business

98.9%
Proportion of government MDAs with a Local Area Network (LAN)

81.9%
Proportion of government MDAs with social media profile

64.2%
Of MDAs have embraced cloud computing services

Sources: NITA-U, 2022; Waema, Rukundo and Mugerwa, 2024.

In summary, big data analytics is curtailed by limited interconnectivity and interoperability, even though Uganda's public sector entities have developed and are implementing data management systems. During the interviews, limited knowledge and the high cost of the infrastructure were mentioned as prohibitive factors that contributed to lower levels of big data infrastructure in the country.

3.4   Human resources

3.4.1   Quantitative analysis of the human resources big data maturity level of public sector entities

A descriptive analysis of the data collected from the public sector entities assessed reveals that the majority (87 per cent) are at the pre-foundation maturity level in terms of human resources, meaning that most of the country's public sector entities currently have no/little awareness of big data analytics at the organization; senior managers have nevertheless started to discuss the requirements in terms of human and financial resources (see Figure 11). These public sector entities have not yet mapped/are starting to map the big data posts that will be required and the external expertise that may be needed for big data project delivery and/or advice. At this maturity stage, the public sector entities have not yet developed/are in the process of developing plans for recruiting and/or developing internal big data analytics skills.

Figure 11: Proportion of public sector entities, by human resources big data maturity level
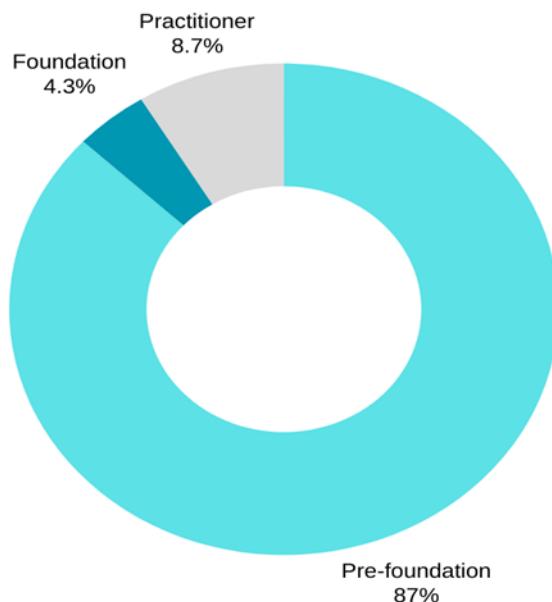
Source: Assessment of Uganda's big data landscape, 2024.

The subthemes for human resources were also analysed. On average, about 71 per cent of the public sector entities assessed were at the pre-foundation level for all five subthemes, save for awareness of big data sources within the entity (see Figure 12). Sixty-one per cent of their IT and statistical staff had foundation-level awareness of big data sources within their entities, meaning that awareness of non-traditional/big data sources is growing within the entities, especially among IT practitioners, statisticians and their senior managers. The assessment also found that the relevant staff had varying definitions of big data and possible big data sources within the entity. Possible use cases were discussed with the interviewees, to give them an understanding of what big data is and what its possible sources are. In addition, according to the self-assessments, 30 per cent of the public sector entities had internal organizational units with data analytics/data science sections or departments, and 70 per cent were at the pre-foundation level in terms of having non-traditional/big data positions. This means that most of the entities have not considered/are starting to consider what is needed in terms of non-traditional/big data/data science positions at their organizations. None of the public sector entities assessed was at the expert maturity level for human resources.

Figure 12: Proportion of public sector entities, by human resources big data maturity subtheme
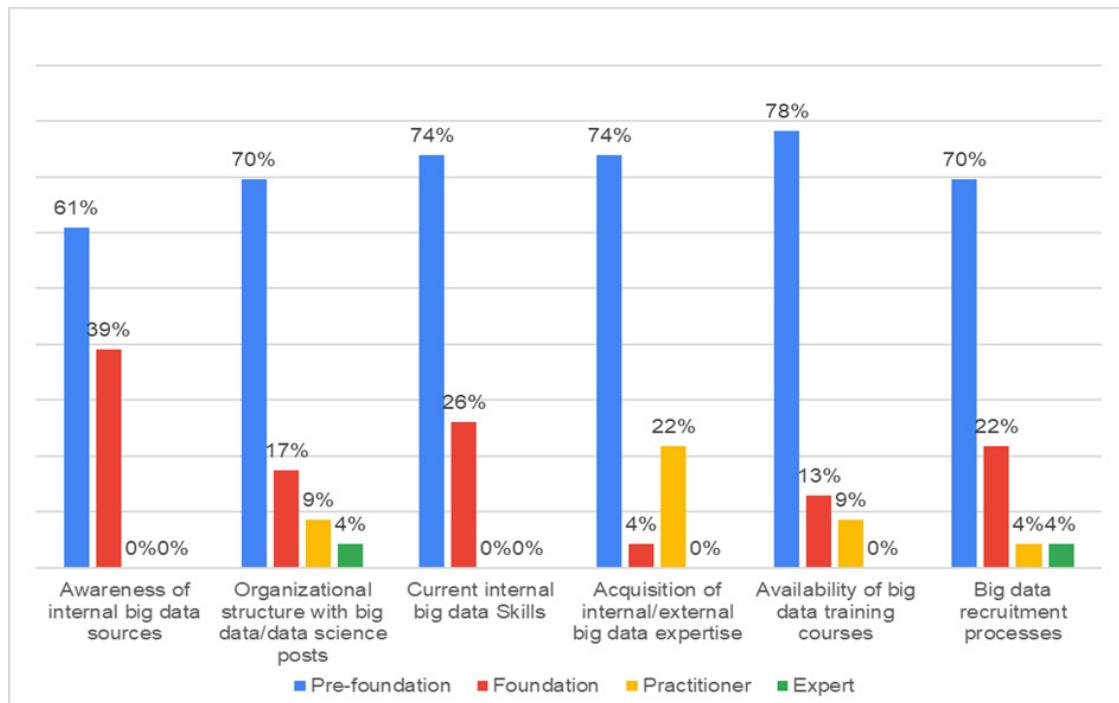
Source: Assessment of Uganda's big data landscape, 2024.

The assessment included a question on which of the big data-related technologies the public sector employees had been trained in and were using. Forty-three per cent of IT cadres and statisticians overall said that they had received training in a big-data related course (see Figure 13); 26 per cent of these had been trained to use relational databases like Oracle and DB2. Some public sector entities (e.g. the Civil Aviation Authority, the UCC, the Uganda Revenue Authority, the National Identification and Registration Authority, the Ministry of Health and the Ministry of Finance, Planning and Economic Development) had either sponsored or nominated (to development partners) some of their staff for training in big data-related courses. As expected with IT and statistical computing professionals, the likelihood that they had been trained in SQL was high but only 11 per cent were using it. A further 11 per cent were using business intelligence tools like enterprise resource planning software. None of the staff said that they had received training in Hadoop or Spark big data framework applications.

Figure 13: Proportion of staff at the public sector entities assessed, by big data-related application use

Not trained — 57%
Spark — 0%
Hadoop — 0%
Business intelligence tools — 11%
No SQL databases — 11%
Other open-source technologies — 11%
Relational databases (e.g. ORACLE, DB2) — 26%
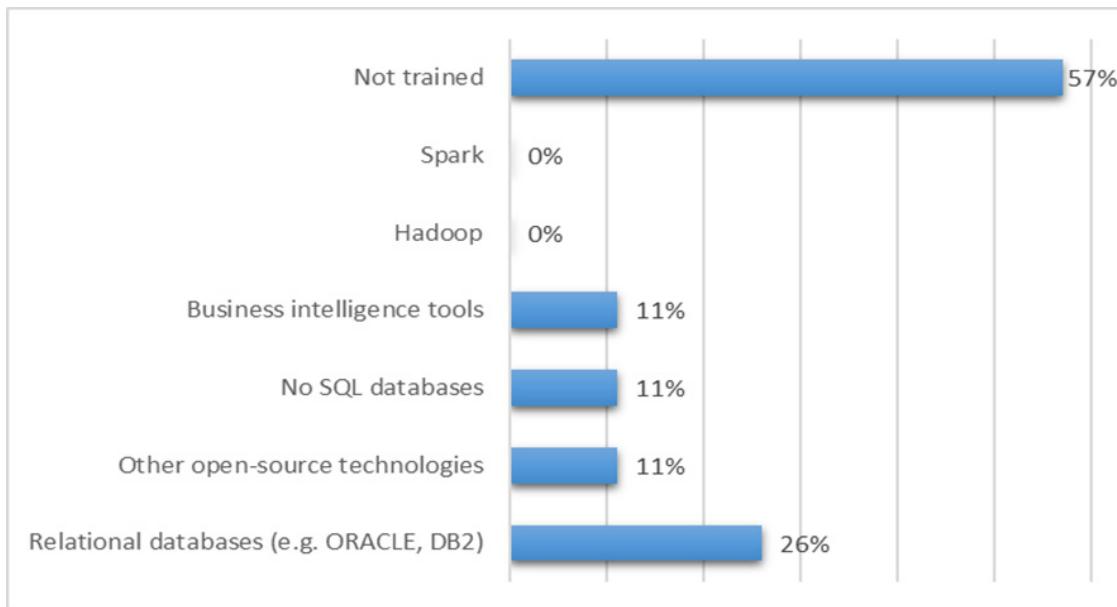
Source: Assessment of Uganda's big data landscape, 2024.

3.4.2 Qualitative analysis of the human resources big data maturity level of public sector entities

According to the Big Data Utilization Strategy (2023–2027), there is no critical mass of skilled big data-related practitioners in Uganda. Big data literacy and competencies are essential to use the tools and technology for big data analytics and enable data to be transformed into intelligence and insights. Makerere University and others have introduced data science courses at the undergraduate and graduate levels to build the country's big data skills capacity. In addition, Data Science Africa, a continental non-profit organization, has also opened a local chapter in Uganda, to help identify and solve problems using local resources and talent.

Assessment of university training in big data-related modules. The assessment revealed that, despite the fact that a number of data science-related courses were offered by several existing institutions in the country, the training courses in big data were by and large theoretical at best, with practice having to be gained in work environments. Six training institutions identified at the outset were interviewed about their capacity to train public sector staff in big data analytics: Makerere University Kampala, ISBAT University, the Uganda Institute of Communications and Technology, Mbarara University of Science and Technology, Mountains of the Moon University and Uganda Martyrs University. All except Makerere University Kampala and ISBAT University said that they had internal resources to provide training in specific big data modules. The curriculum for several undergraduate degrees at Makerere University Kampala was modified in 2021 to include big data-related modules such as Introduction to Machine Learning and Cloud Computing. These are largely theoretical. ISBAT University relies on internal experts, some local and some outsourced from computing institutions in India, to train students in applied big data concepts and applications, including Hadoop and Apache Spark.

Several public sector entities enabled their staff to take big data-related courses. For example, the National Identification and Registration Authority sent its data staff to India for a month of training in management of the national ID registration system and other database management

processes. Others (e.g. the Civil Aviation Authority and the Ministry of Finance, Planning and Economic Development) had sent staff members to ISBAT University for training in advanced Oracle data management. The UCC had had some of its staff trained in foundational and practical big data analytics by experts from the GSMA. During the workshop on the review of the resource envelope for the financial year 2024/25, organized by the Ministry of Finance, Planning and Economic Development in March 2024, the Ministry called for the ability of the Uganda Revenue Authority to use big data to detect tax evasion and grow the tax register to be improved by expanding the authority's big data human resource base, by either recruiting big data scientists or training existing staff (Kiiza, 2024).

According to the report entitled *Situation Analysis of Uganda's Internal and External Data Ecosystem, 2024* (Waema, Rukundo and Mugerwa, 2024), the level of ICT-related skills within both government and non-governmental entities remains relatively moderate.

3.4.3   Big data analytics skills-gap analysis

The assessment was accompanied by a big data analytics skills-gap analysis, with a view to aligning the efforts of key stakeholders to update relevant ICT policies and strategies and to implement a number of big data projects within public sector entities, especially on the capacity-building front.

According to the analysis, the public sector entities interviewed see the need to improve the skills of the people going through the educational system and subsequently absorbed by them. The analysis focused on IT professionals and statisticians at the relevant public sector entities to assess the existing big data analytics skills gaps. The Big Data Competency Assessment Tool developed by the GWG was applied to 35 staff members from 23 public sector entities. Twenty-six per cent of the ICT and statistical staff members interviewed reported that they had been trained *inter alia* in relational database management for big data; 69 per cent had at least some basic programming skills; and 80 per cent reported that they had at least basic competency in data management. These were the pre-requisites for them to be part of the proposed practical big data training. There was no segregation of data skills between data engineers and data scientists, and efforts to integrate these positions within existing organization charts were costly

The analysis recommended practical training to ensure that the public sector entities had competent IT cadres and statisticians with practical big data analytics-related skills. It also identified key stakeholders able to play a critical role in implementation and use case applications that can be explored to guide particular training sessions. The big data competency levels are detailed in Annex 11.

3.5   Big data application

3.5.1   Quantitative analysis of the big data application maturity level of public sector entities

The application of big data analytics within public sector entities was also assessed. As seen in Figure 14, the majority (91.3 per cent) of the public sector entities analysed were at the pre-foundation maturity level, meaning that they had not applied any big data tasks or that such tasks might have been undertaken by individual employees on an ad hoc basis, out of interest.

The public sector entities concerned had not developed procedures for obtaining, processing and sharing big data.

Roughly 9 per cent of the public sector entities analysed were at the foundation level, meaning that big data tasks were only rarely undertaken, by designated teams. The procedures for acquiring, processing and sharing big data had been specifically designed for the team's needs (fit for purpose).

None of the public sector entities analysed were at the expert maturity level, i.e. the level where big data tasks are carried out by teams specifically recruited for that purpose and constantly conducting such tasks within the entity.

Figure 14: Proportion of public sector entities, by big data application maturity level

Foundation 8.7%
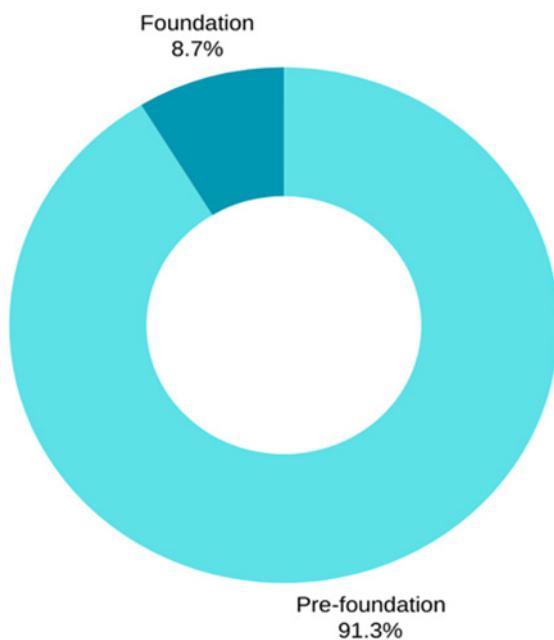
Pre-foundation 91.3%

Source: Assessment of Uganda's big data landscape, 2024.

The big data application subthemes were also analysed. On average, about 71 per cent of the public sector entities assessed were at the pre-foundation level for all five subthemes (see Figure 15). Eighty-three per cent were at the pre-foundation level when it came to conducting big data tasks or projects, meaning that the entity had no big data tasks/projects but that Individual data analysts/statisticians/IT officers had started to become interested in the subject. Seventeen per cent reported that they were carrying out some big data analytics-related projects.

Figure 15: Proportion of public sector entities, by big data application subtheme
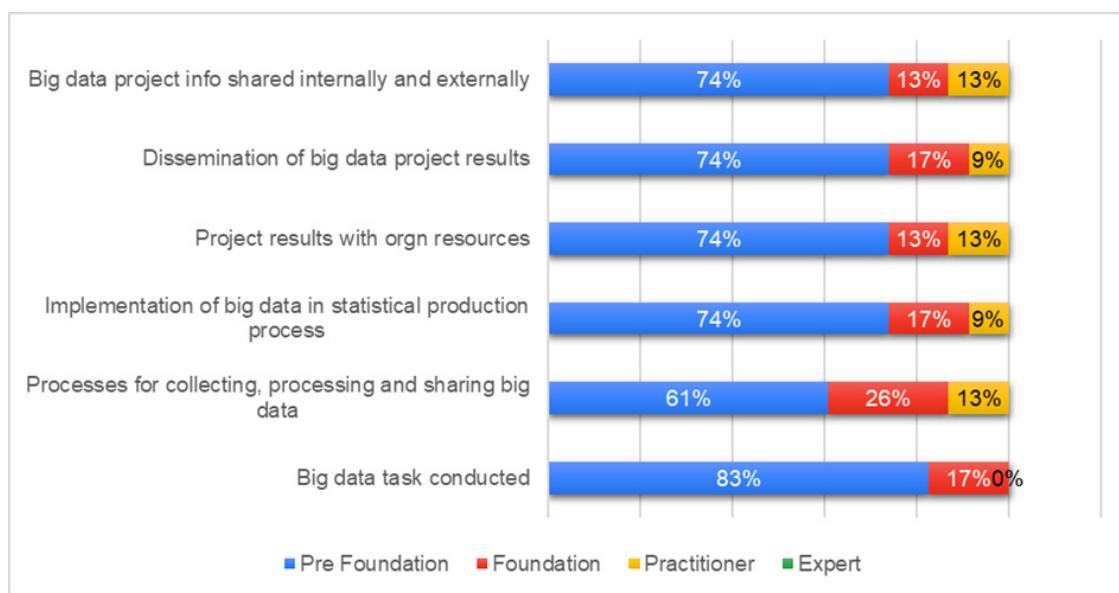
Source: Assessment of Uganda's big data landscape, 2024.

3.5.2 Qualitative analysis of the big data application maturity level of public sector entities

The public sector entities had glaring issues when it came to obtaining, processing and analysing data, including potential big data. Firstly, there is a culture of limited data use in the country, especially in many governmental and private sector organizations. According to the report entitled *Vulnerability and resilience: How does Uganda's data ecosystem inform social protection systems?* (Development Initiatives, 2024), these organizations and institutions fall into two categories: those that have no interest in using data and those that want to use data but cannot. Most of those in the first category make decisions based on priorities rather than evidence; most of those in the second category do not have the skill set, time or financial resources needed to use the data available to them – this also affects the use of big data.

A few organizations in the country have started to use big data at varying levels, as will be seen below.

According to the Big Data Utilization Strategy, Makerere University's Artificial Intelligence Lab carries out research and implements big data and artificial intelligence projects in collaboration with the Government and the private sector. Other universities (e.g. Mbarara University of Science and Technology) have opened similar labs. Interviews with Mbarara University reveal that big data pilot projects are carried out in the public health field only, in collaboration with a university from the United States of America. The UN Global Pulse initiative has opened its first African lab in Kampala and conducted a few pilot projects, e.g. using call data records and satellite imagery data to estimate population mobility in and out of Kampala and poverty trends, respectively. It is planning to conduct several other big data use case projects in the near future.

The big data initiatives below are presented in two different categories: public sector initiatives and private sector initiatives.

Public sector initiatives

The **Uganda Revenue Authority** has rolled out solutions to facilitate taxpayer compliance and interaction. These include an electronic receipting and invoicing system for e-filing and e-invoicing; digital tax stamping for manufacturers; customer relationship management tools; non-intrusive inspection with scanners at customs borders; a bond warehouse management system; rental income management solutions; a call centre with multiple touchpoints (WhatsApp, web, e-mail); and several taxpayer interface enhancement systems (e.g. web portal, mobile app and a new USSD menu). According to the commissioner for IT, the Authority has started to draw insights from taxpayers using the big data flows in the different formats mentioned above. It has a data centre and is exploring data lake capabilities. It piloted a trial big data application in 2016; the pilot is being implemented by the Global Voice Group, a private contractor that collects and processes billions of datasets, turning them into actionable information for government institutions, regulators, central banks and revenue authorities. The partnership between the Global Voice Group and the Uganda Revenue Authority started in 2016. That year, the Group piloted and implemented the Telecommunications Intelligent Monitoring System in Uganda. The system's purpose was to help the authority, in conjunction with the **UCC**, to improve revenue assurance, quality of service and security in the telecommunication sector. Since its installation, the system has helped the Authority and the UCC ensure regulatory compliance, curb fraud and stimulate domestic revenue mobilization, using technology that collects and analyses various data to quality-check self-declared returns. The Global Voice Group added the Data Monitoring System in 2019, to collect more varied information on data traffic. More specifically, the Data Monitoring System helps to create accurate forecasts through predictive analysis of the required capacity and to identify new revenue streams. For example, obtaining real-time information on sales through e-transactions and on excise duty on airtime are good quality checks for self-declared returns

The **Ministry of Health** digital strategic plan (National e-Health Strategy 2017–2021) aimed to develop and harness big data adoption and utilization with support from development partners, mainly the United States Agency for International Development. This was to be done by developing and implementing big data and open data guidelines for health, to facilitate analytics, research and innovation. Big data and cloud computing were adopted but not extended to all health centres. The Ministry is currently piloting the use of data analytics to collect, analyse and share real-time data from health facilities and other sources, to inform decision-making and improve health outcomes. An example is the SMS illness surveillance system, called mTrac, which is operational in over 5,700 health centres nationwide and reported to have provided early warnings of multiple disease outbreaks in Uganda**.** mTrac is a mobile health app that allows health workers in Uganda to submit weekly health surveillance data via SMS. An SMS alert is sent to every member of the district health management team for immediate response when any preset data threshold is reached. Many of these initiatives remain small in scale or at the pilot stage, according to the interview responses, but existing datasets could be mined to understand local disease trends, and data formats harmonized to facilitate analysis using big data mining and machine-learning techniques. The Ministry of Health is currently piloting the use of big data to track the spread of diseases and monitor the effectiveness of health interventions via the different systems that it uses to collect data, i.e. mTrac, DHIS2, the Electronic Medical System and the Electronic Community Health Information System, and any other social media and radio data sources accessible to it.

The **Ministry of Finance, Planning and Economic Development** collects large volumes of varied data through its budget website. It also produces disaggregated financial data, including data from district work plans and performance reports, which are apparently stored in Oracle databases as big data. In addition, at the **Bank of Uganda**, fluctuations measured by similar X or Twitter-based mood tracking tools and Facebook posts can be predictive of economic trends in the population (e.g. changes in stock market averages from the Uganda Securities Exchange) and used to triangulate Business Perception Index results, as monitored through customer perceptions (Kihangire, 2022). Big data is not yet structured at either the Ministry or the Central Bank but both have considered hiring external ad hoc big data experts to develop big data infrastructure to try and mine such data. The Ministry has also sponsored training for some of its staff in big data-related courses. ISBAT University trained the staff in Oracle database management.

The Food and Agriculture Organization of the United Nations and the European Union funded a project called **AgriInvest** with the **Uganda Development Bank.** In 2021 the project began collaborating with Dalberg Data Insights to pilot the use of big data analytics (through call record data from a mobile network operator) and thereby assess the impact of the Bank's loans in terms of poverty reduction**.** Specifically, the Dalberg Data Insights project trained bank staff members in big data analytics and how to scale up operations in big data use. The bank is currently in the process of procuring big data analytics solutions.

In 2018, Dalberg Data Insights launched AIDA, the action insights data platform developed in partnership with UNCDF and the Belgian Government (through Belgium's Enabel). AIDA was tested in Uganda, where Dalberg Data Insights has built four data products in the form of algorithms and dashboards using big data, censuses and surveys. The data products were co-designed and tested with **Hunger Fighters Uganda, UNCDF MM4P, ROM Transportation Engineering** and the **Kampala Capital City Authority.** The dashboards support data-driven decisions about food security, financial inclusion and urban planning, but currently to a lesser extent because data privacy regulations limit the ability of key data generators, especially mobile network operators, to share customer data. The Kampala Capital City Authority has an indicator that tracks the number of audits undertaken using big data analytics.

The **Uganda Police Force**, which reports to the **Ministry of Internal Affairs**, collects a large volume of high-speed data manually at stations in various parts of the country, including by recording cases on station diaries. The Directorate of Research and Planning has yet to start storing past data digitally, for ease of access and analysis. To date, 78 officers have been trained to use the newly developed Intelligent Transport Monitoring System at the Uganda Police ICT Research, Development and Innovation Centre in Kikandwa, Wakiso District. The training was conducted in collaboration with Global Security, a Russian-based firm. The system merges sensing, analysis, control and communication technologies to enhance ground transportation safety, mobility and efficiency with a comprehensive security solution. It is the responsibility of the **Ministries of Works and Transport**, **of Security** and **of Internal Affairs** and is operated by the police. It employs advanced video management, automatic number plate recognition and facial recognition technology to promote security and compliance with traffic regulations. It promises to show the power of big data analytics to resolve and predict poor transportation practices and crime.

The **Uganda Bureau of Statistics** curates data collected by it and a range of administrative systems. Rather than use the National Data Centre, the Bureau is planning to build a data science laboratory/centre in Entebbe, to collect and analyse data; from the interviews conducted,

however, it needs capacity building and infrastructure for that purpose. The Bureau is planning simply to harness new data sources, including big data, data science, blockchain and geospatial technologies, to produce statistics and to that end will train relevant staff in those topics. As the country's statistics authority, the Bureau started piloting use cases with **UN Global Pulse** in 2018. It explored the use of real-time mobile data to develop a population mobility matrix generated from millions or billions of call data records and presented in a matrix of lights representing the movement of people in and out of Kampala throughout a particular month. It also piloted the use of satellite imagery to monitor poverty by viewing images of buildings with sheet-metal roofs between 2012 and 2014 in Gulu town. The number of such buildings was the proxy indicator used in that case. In addition, the Bureau piloted the use of radio content data to conduct real-time analyses of public perceptions and sentiments on selected topics relating to public service delivery. According to the Bureau, a number of those pilots provided **citizen-generated data** that the Bureau is now endeavouring to track. The limited legal framework, lack of human capacity and inaccessibility/high cost of obtaining such data has negatively affected the sustainability of the Bureau's use case projects.

Private sector initiatives

Of the private sector **telecommunication companies interviewed**, **the largest, MTN** and **Airtel**, have played a major role in the creation of new approaches to the analysis of cell phone data in Uganda. For example, MTN, which has over 19 million users in Uganda, is a great source of exhaust data from mobile phone records. MTN is the only private company that has acquired and is using Hadoop applications to infer customer behaviour and socioeconomic welfare from mobile phone use patterns. One notable example of a big data source at MTN is the data generated by MomoPay, the mobile money application. MomoPay allows users to deposit money into mobile phone-based accounts and to transfer money to other account holders. It is used about 540,000 times per month. Withdrawals can be made through mobile money agents/airtime retailers, who essentially serve as both automated teller machines and wire transfer agents. Airtel Uganda houses its big data analytics infrastructure and application at its headquarters in India.

Another source of information is the flood of data generated by mobile health applications. Donor agencies are investing heavily in mobile health. Notable examples are **Medic Mobile** and **ROCKET Health**, which were launched to foster collaborative means of bringing mobile-based health solutions to scale in urban and peri-urban areas in Uganda's Central region. A review of the range of mobile health applications is beyond the scope of this report, but of particular interest to Uganda is surveillance and patient monitoring information transmitted by mobile health workers to central databases.

As much as public sector entities and private sector actors acknowledged that a role existed for big data in the Uganda's development, they considered lack of finance, limited infrastructure, unintegrated data sources, lack of skills and capacity, and limited cooperation among stakeholders as major obstacles to achievement of that goal.

4 Stakeholder analysis

4.1 Introduction to the stakeholder analysis

The stakeholder analysis was used to produce a systemic list of all stakeholders participating in the Big Data Utilization Strategy. It defines legal and policy requirements for stakeholder engagement and provides a stakeholder analysis of all relevant potential project-affected parties, including members of vulnerable groups.

4.2 Objectives of the stakeholder analysis

The stakeholder analysis was applied to all pillars of the Big Data Utilization Strategy and potential big data development projects being planned by the Government. It identified stakeholders to engage with while assessing the big data landscape. Its objectives were as follows:

- To identify the stakeholders shaping the big data landscape in Uganda;
- To identify the stakeholders' priorities and concerns as they relate to adoption and implementation of the Big Data Utilization Strategy.

4.3 Stakeholder analysis methodology

A stakeholder scoping tool was developed and agreed at the outset by the Ministry of ICT and National Guidance and ITU project team members. In addition, a desk review was conducted of a stakeholder analysis done for related projects. The Big Data Utilization Strategy and the draft National Data Strategy were the main documents reviewed in this case. The key informant interviews of the stakeholders identified led to other stakeholders being identified and they were then also interviewed, in a "snowball" process.

4.4 Stakeholder mapping

The stakeholders in the Big Data Utilization Strategy are individuals or groups (parties) that can be affected by the potential outcomes, either directly or indirectly and both positively or negatively (implementation-affected parties) or have an interest in the related interventions (other interested parties). The stakeholder analysis therefore encompasses identification of the stakeholder groups that are likely to influence or be affected by the proposed project components, either positively or negatively, and their organization according to the potential impact of the activities on them.

To encourage dialogue and feedback among the community of (big) data beneficiaries and data-driven value-creating entities, the Big Data Utilization Strategy proposed a multi-stakeholder ecosystem group comprising the following:

a) Data owners or subjects;

b) Data users (users of (big) data-driven services) including ordinary citizens;

c) Data controllers and processors;

d) Data-driven service providers and start-ups;

e) Data policy-makers, planners and practitioners;

f) International organizations, development partners and foreign collectors and users of Ugandan data;

g) Industry players and academic institutions working on how data can drive the Ugandan economy; and

h) Proposed members of the Big Data Utilization Strategy data governance structure, which consists of the Ministry of ICT and National Guidance, a public institution responsible for data governance; the Uganda Bureau of Statistics; the programme/industry regulator(s); the programme/industry development agency; the programme/industry research institutes; the judiciary; and tertiary institutions (the member must be the sector/industry specialist).

The stakeholders can be classified based on:

a) Their roles and responsibilities in the big data ecosystem/potential big data project;

b) Their influence/interest in the potential big data project;

c) Whether they are direct or indirect beneficiaries; and

d) Whether they are vulnerable groups.

The Big Data Utilization Strategy lists the key stakeholders involved in its development. This assessment targeted those stakeholders. The list was further refined by relevant team members from the ministry concerned and ITU big data experts. As will be seen below, the "snowballing" effect of interviews with other development partners in the digital transformation space, such as UNDP and UN Global Pulse, added other key stakeholders.

The key stakeholder groups based on access to benefits are as follows:

a) Implementation-affected parties

Direct beneficiaries

- Ministry of ICT and National Guidance
- Uganda Bureau of Statistics
- Personal Data Protection Office
- Uganda Communications Commission
- National Information Technology Authority – Uganda (NITA-U)
- Ministry of Trade, Industry and Cooperatives
- Ministry of Internal Affairs
- Ministry of Finance, Planning and Economic Development
- National Identification and Registration Authority
- Uganda Revenue Authority

Indirect beneficiaries

- Investors and traders
- Academic institutions
- Civil society organizations
- Donor community and international organizations
- Service providers (conference facilities, air travel, research)
- Consultants

b) Other interested parties, including civil society organizations (NGOs and community-based organizations), and academia.

c) Public and other vulnerable groups

Overall stakeholder groups at different stages of the proposed project (i.e. preparation, implementation and closure) are presented in Table 1. Considering that stakeholders are likely to change over the course of a project, the stakeholder list will be revised and updated continuously to include new stakeholders with access to additional information.

Stakeholder mapping framework

Stakeholders were mapped according to the framework shown in Table 7.

Table 7: Stakeholder mapping framework

Interest (wanting to know/be part of)	Influence (capacity to have a positive or negative effect)	Type	Action
High	High	Primary (promoters)	• Manage closely (focus on this group) • Engage and consult regularly • Involve in governance/decision-making • Inform
Low	High	Secondary (defenders)	• Keep satisfied • Consult on areas of interest • Inform • Try to increase the level of interest
High	Low	Tertiary (latent)	• Keep Informed • Engage as needed • Try to increase the level of influence
Low	Low	Others (apathetic)	• Monitor • Contact occasionally • Try to increase the level of interest

Source: Draft National Data Strategy, 2024

Uganda's Big Data Utilization Strategy has many stakeholders. Figure 16 maps the various stakeholders following the framework in Table 7.

Figure 16: Stakeholder mapping results

Source: Big Data Landscape Assessment, 2024.

As is indicated in Figure 16 above, the majority of the stakeholders listed were identified thanks to the "snowball" effect of the key informant interviews, beginning with the project team comprised mainly of Ministry of ICT and National Guidance staff. Other stakeholders were identified through interviews with other development partners, especially UNDP, GIZ and UN Global Pulse. A stakeholder scoping assessment tool was employed to collect this information and segregate the stakeholders based on their influence and interest, both positively and negatively. They were classified accordingly as primary/promoters (high interest and high influence); secondary/defenders (low interest and high influence); tertiary/latent (high interest and low influence); or others/apathetic (low interest and low influence).

4.5   Stakeholders and engagement preferences

Table 8 below shows how it is proposed to engage and communicate with the stakeholders identified. For each stakeholder, the table shows the category, briefly describes their mandate/role, and indicates their interest/influence rating and preferred communication notification tool. The interests and influences of the various stakeholders are also shown as the result of the qualitative analysis of the stakeholder scoping exercise and the desk review secondary analysis.

Table 8: Summary of stakeholders identified and engagement preferences

Stakeholder	Category/department	Mandate/role	Interest	Stakeholder group (IAP/OIP*)	Influence	Preferred notification means (e-mail, phone call, letter)	Specific needs (accessibility, large print, daytime meetings)
Ministry of ICT and National Guidance	Government	Regulate ICT standards and services	High	PAP	High	Meetings, formal letter, e-mail, phone call	Technical know-how Accessibility Availability
Uganda Bureau of Statistics	Government	Collect and analyse government data	High	PAP	High	Meetings, formal letter, e-mail, phone call	Technical know-how Accessibility Availability
Personal Data Protection Office	Government	Data protection	High	PAP	Medium	Meetings, formal letter, e-mail, phone call	Technical know-how Accessibility Availability
UCC	Government	Oversee digital transformation and telecommunication companies	High	PAP	High	Meetings, formal letter, e-mail, phone call	Technical know-how Accessibility Availability
National Information Technology Authority Uganda	Government	E-government service delivery	High	PAP	High	Meetings, formal letter, e-mail, phone call	Technical know-how Accessibility Availability
Ministry of Trade, Industry and Cooperatives	Government	Trade regulation	High	PAP	Medium	Meetings, formal letter, e-mails, phone call	Technical know-how Accessibility Availability
Ministry of Internal Affairs/Uganda Police Force	Government	Oversee internal security and administration	High	PAP	High	Meetings, formal letter, e-mail, phone call	Technical know-how Accessibility Availability

Table 8: Summary of stakeholders identified and engagement preferences (continued)

Stakeholder	Category/ department	Mandate/role	Interest	Stake- holder group (IAP/OIP*)	Influence	Preferred noti- fication means (e-mail, phone call, letter)	Specific needs (accessibility, large print, daytime meetings)
National Identification and Registration Authority	Government	Issue ID cards	High	PAP	Low	Meetings, formal letter, e-mail, phone call	Accessibility Availability
Uganda Revenue Author- ity	Government	Collect revenues	High	PAP	Low	Meetings, formal letter, e-mail, phone call	Accessibility Availability
Ministry of Finance, Planning and Economic Development	Government	Formulate economic policies	High	PAP	High	Meetings, formal letter, e-mails, phone call	Accessibility Availability
Other private investors and traders	Private sector	Make data-based invest- ment and business decisions	Low	OIP	Low	Meetings, formal letter, print media	Accessibility Accurate information
Telecommunication companies	Private sector	Make data-based invest- ment and business decisions	High	PAP	High	Meetings, formal letter, print media	Accessibility Accurate information
Financial institutions, especially commercial banks	Private sector	Make data-based invest- ment and business decisions	High	OIP	High	Meetings, formal letter, print media	Accessibility Accurate information
Universities planning to roll out data science courses	Academia	Research and teaching	High	PAP	High	Meetings, formal letter, print media	Accessibility Reliability
Other academic institu- tions	Academia	Research and teaching	High	OIP	Low	Meetings, formal letter, print media	Accessibility Reliability

Table 8: Summary of stakeholders identified and engagement preferences (continued)

Stakeholder	Category/department	Mandate/role	Interest	Stake-holder group (IAP/OIP*)	Influence	Preferred notification means (e-mail, phone call, letter)	Specific needs (accessibility, large print, daytime meetings)
Civil society organizations	Including NGOs and fixed base operators	Advocacy and holding governments to account	Low	OIP	Low	Meetings, formal letter, print media	Accessibility Timing Stakeholder participation
ITU	Donor community	Development assistance	High	PAP	High	Meetings, formal letter, print media	Accessibility Inclusion Gender-responsive data
UNDP	Donor community	Development assistance	High	OIP	High	Meetings, formal letter, print media	Accessibility Inclusion Gender-responsive data
UN Global Pulse/UNDP	Donor community	Development assistance	High	OIP	High	Meetings, formal letter, print media	Accessibility Inclusion Gender-responsive data
Enabel	Donor community	Development assistance	High	OIP	High	Meetings, formal letter, print media	Accessibility Inclusion Gender-responsive data
GIZ	Donor community	Development assistance	High	OIP	High	Meetings, formal letter, print media	Accessibility Inclusion Gender-responsive data

Table 8: Summary of stakeholders identified and engagement preferences (continued)

Stakeholder	Category/department	Mandate/role	Interest	Stake-holder group (IAP/OIP*)	Influence	Preferred notification means (e-mail, phone call, letter)	Specific needs (accessibility, large print, daytime meetings)
JICA	Donor community	Development assistance	High	OIP	High	Meetings, formal letter, print media	Accessibility Inclusion Gender-responsive data
Other donors	Donor community	Development assistance	High	OIP	Low	Meetings, formal letter, print media	Accessibility Inclusion Gender-responsive data
The public and vulnerable groups	Those who may be more likely to be adversely affected by the potential project impacts and/or more limited	Provide data on issues that affect them and make decisions based on data	High	OIP	Low	Meetings, formal letters, print media	Daytime meetings Local languages Large print Accessibility Gender and culturally appropriate consultations

* IAP: implementation-affected party / OIP: other interested party

5 Conclusions and recommendations

5.1 Conclusions

This report has established the situation analysis for big data in Uganda's public sector entities in particular, concluding that most of those assessed are at the pre-foundation big data maturity level.

Legal and policy frameworks

In all, 60.9 per cent of the public sector entities assessed were at the pre-foundation maturity level in terms of legal and policy frameworks for big data, meaning that they had not yet developed or had only started planning to put in place legal and regulatory frameworks for big data. The explanation is that there is no national policy requirement mandating public sector entities to have their own policies and regulations related to (big) data. Several of the public sector entities concerned also lacked the capacity to develop such policies.

Two of the country's three main telecommunication operators (MTN and Airtel) were at practitioner maturity level in terms of legal and policy frameworks for big data. As major data producers, they had well-developed internal guidelines and policies for big data. The third operator (Uganda Telecom) was at the pre-foundation level but in the process of developing regulations and guidelines for big data.

Within the banking sector, four of the country's 34 commercial banks were at the foundation maturity level while another four are at the practitioner maturity level in terms of legal and policy frameworks for big data analytics. The rest were at the pre-foundation maturity level but also interested in developing their own data analytics departments, to be able to compete with their colleagues.

Uganda's big data ecosystem is governed by several high-quality policies, laws and strategies. The Big Data Utilization Strategy (2023–2027), the Access to Information Act 2005 and the Uganda Data Protection and Privacy Act 2019 are well crafted. Unfortunately, existing policies, laws and strategies are not widely understood by the relevant organizations and individuals, not well enforced and in some cases still under development.

The Uganda Bureau of Statistics is mandated to coordinate government-wide data collection but has unfortunately struggled to bring other agencies into the national statistics system.

No government agency is mandated to coordinate data management, and the void thus created means that the matter is largely unattended. This hamstrings the coordination efforts needed for public sector entities to harmonize and utilize big data.

The Big Data Utilization Strategy is well structured but lacks a comprehensive implementation framework with clear targets, allocation of roles and responsibilities, costs, and a monitoring and evaluation framework. The strategy does stipulate that it will be guided by the monitoring and evaluation framework for the Digital Uganda Vision but that framework is not accessible.

There is limited awareness among stakeholders of existing data policy, legal and regulatory frameworks in Uganda. Several interviewees, for example, had very little knowledge of what the policies aimed to achieve specifically or how they were to achieve it.

There is limited regulation of data held by non-State actors, such as telecommunication companies and tech companies, and by non-State actors domiciled outside Uganda but accessible there, meaning that cross-border data flows are affected.

The regulations set out in the Data Protection and Privacy Act 2019 and its 2021 guidelines focus on personal data protection. Regulation of non-personal data, which is equally important for improved governance of big data initiatives, is not considered.

The review of the policy, legal and regulatory environment showed that Uganda has laws, standards and regulations relating to data security, collection, sharing, archiving and use. Their enforcement remains wanting, however, and this has hampered the country's efforts to take data-sharing initiatives that would enable big data initiatives to thrive in public and private sector entities.

Big data infrastructure

Most (73.9 per cent) of the public sector entities assessed were at the pre-foundation maturity level for big data infrastructure, meaning that very few had infrastructure configured to collect and analyse big data obtained from different sources. A further 17.4 and 8.7 per cent were at the foundation and practitioner maturity levels, respectively. A few had infrastructure that could be scaled up to analyse big data. Lack of funding to purchase big data infrastructure was one of the inhibiting factors mentioned.

All three major telecommunication companies had the infrastructure, in terms of data centres, needed for big data analytics, as did 23 per cent of the financial institutions assessed.

In all, 64.2 per cent of the public sector entities assessed had embraced cloud computing. The majority (54.1 per cent) were using the government data centre cloud services offered by NITA-U. Concerns about high costs and security were prevalent, especially among those that had not embraced cloud computing services.

Fifty-nine per cent of the public sector entities assessed were offering services to the public online, predominantly via web applications.

The NITA-U data centre had the infrastructure needed to store and analyse big data, if configured to do so.

Human resources for big data analytics

The majority (78.3 per cent) of the public sector entities assessed reported that they were at the pre-foundation maturity level in terms of human resources for big data, meaning that they did not have or had only started planning to hire expertise to implement big data projects.

All the telecommunication companies and 23 per cent of the financial institutions assessed had set up data analytics departments for handling big data within their organizations.

Sixty-four per cent of the IT and statistics staff at the public sector entities assessed had foundation-level awareness of big data sources within their organization. All relevant staff at the telecommunication companies and commercial banks were aware of big data.

It is worth noting that the staff members at the public sector entities had different and incorrect definitions of big data. The majority defined big data as nothing more than large volumes of data. Most did not have an exact definition of what constitutes big data.

Most sectors were lacking in the skill sets needed to implement big data analytics. The IT and statistics staff at the public sector entities assessed had some foundational data management skills to build on but lacked the core skills needed to implement big data projects.

Of the five training institutions assessed, one had internal capacity to provide training in both the foundational concepts and the practical aspects of big data. The rest relied on foreign expertise to deliver practical training.

Application of big data analytics

The majority (91.3 per cent) of the public sector entities assessed were at the pre-foundation maturity level for the application of big data analytics, meaning that most had not engaged in any big data tasks or big data tasks were being undertaken on an ad hoc basis by individual employees, out of interest. This result is hardly surprising, given the absence of infrastructure and capacity to implement big data tasks revealed above.

Data management systems across public sector entities are quite extensive but have limited interconnectivity and many are not being utilized optimally. This curtails the holistic analysis and use of data, including possible big data analysis.

Data access remains a general problem in Uganda. The majority of the interviewees said that the biggest problem was the inability to access primary big datasets from data producers, mainly because they feared that they would violate data privacy regulations and/or expose sensitive information.

There is a culture of limited data use in Uganda, especially among the institutions and individuals interviewed. Many of the public sector entities and private sector actors assessed made decisions based on priorities rather than evidence.

Uganda's (big) data ecosystem faces a major financing problem. There is not enough investment and funding for data activities, especially pilot projects. What funding does exist for the few big data pilot projects comes primarily from donors.

5.2   Recommendations

Legal and policy reform and awareness

For big data utilization to be successful, it is essential to drive legislative changes to provide a legal framework for accessing, processing and utilizing big data in official capacities. The Access to Information Act 2005, the Electronic Transactions Act 2011 and the Data Privacy and Protection Act 2019 need to be amended to strengthen enforcement. It would be good to introduce benchmarks from countries that have done this successfully (e.g. Estonia and Rwanda).

Public sector entities with no internal data governance frameworks comprising data management regulations and guidelines should be encouraged and helped to develop them. Exchange programmes should be established between public sector entities with internal data management governance frameworks and policies and those without those tools.

Awareness of the relevant acts should be heightened, especially those related to data privacy and responsible data-sharing. Massive awareness-raising campaigns should be organized among relevant public and private sector entities. The National Personal Data Protection Office should be helped to coordinate revisions of the Uganda Data Privacy and Protection Act 2019 and engage in awareness-raising among government agencies, NGOs and citizens.

Draft policies and strategies related to big data should be finalized. The National Open Data Policy 2017 is still in draft form and needs to be finalized urgently. Great progress had been made on the development of the National Data Strategy but all relevant stakeholders must now make a concerted effort to finalize it. It is important to put in place a national policy to govern data at both government and non-State level.

The Big Data Utilization Strategy implementation framework, with its monitoring and evaluation framework, has been partially discussed but the public and private sector stakeholders involved in its development need to conduct further reviews before it is finalized and adopted.

In addition, in order to address data privacy and protection concerns while improving data access, mechanisms should be established for the publication of anonymized/non-personal data from various public data sources and systems. The Uganda Bureau of Statistics and NITA-U, as the coordinator of official data collection and monitor of IT developments among public sector entities, respectively, should be supported in spearheading this undertaking. At the same time, memoranda of understanding should be drawn up between public sector entities, civil society organizations and private sector participants as a critical first step in improving data-sharing, with embedded clauses safeguarding personal identity.

The Uganda Bureau of Statistics and the Ministry of ICT and National Guidance should spearhead the strengthening of the Big Data Utilization Strategy by reviewing and finalizing the proposed implementation framework. An implementation and monitoring/evaluation framework have been proposed in this report, and every effort should be made to review and adopt them as part of the strategy.

Big data infrastructure acquisition

A business model is needed that outlines the roles and responsibilities, beneficiaries and funding arrangements for a successful big data initiative. Uganda should be more involved in the UN Regional Hub for Big Data and Data Science, and the East African Digitalization Regional Integration Project, which is funded by the World Bank, should be fast-tracked to leverage lesson learning and financial support available for big infrastructure.

Public-private partnerships should be explored and brokered to finance some of the proposals for big data infrastructure and capacity-building initiatives set out here. A good example is the collaboration between the Uganda Bankers Association, led by selected private sector commercial banks, the Uganda Development Bank and the Central Bank in Uganda.

Practical human resource capacity building in big data analytics for public sector entities

IT officers and statisticians should take practical big data training courses, to beef up the foundational knowledge they already have/can easily access about big data. They should do this when their respective ministries and agencies have acquired the relevant big data software

applications, some of which are open-source. Available local big data training resources are recommended. Theoretical training for IT cadres and statisticians will be effective and efficient only if coupled with use case applications, which have been proposed in a separate training assessment report that contains a training programme proposal for relevant staff; merging the two will provide more effective results. It is recommended to start gradually with No-SQL training.

The Government of Uganda, with the support of its development partners, should consider investing in the placement, hiring and retention of skilled data scientists at public sector entities once the recruitment ban has been lifted.

Big data application and use cases

In line with the above recommendations, several big data use case applications have been proposed by this assessment. Piloting use case applications and showcasing the benefits thereof are the most effective means of encouraging public and private organizations to buy into big data. One of the use case applications proposed is to help the Uganda Bureau of Statistics explore the use of mobile phone big data and satellite imagery data for official statistics. Another is to work with the Ministry of Education and Sports to obtain teacher participation and student enrolment data from the Education Management Information System, which is in the final stages of completion, and add them to mobile phone data, exam data from registries/marking bodies and other sources amalgamated in a data lake. These data can be used to monitor student performance, enhance understanding of teaching practices, and help parents and students identify the best fit with a school. Big data of this kind can be analysed as a complement to data from traditional sources, to enable new training/delivery regimes that tailor lessons to performance. It can also be used to monitor progress towards government educational goals. A mapping platform can be used to show areas where educational resources are lacking.

Tweets and Facebook data can be analysed to understand citizens' feelings about policies and government. The analysis can reveal citizens' positive/negative sentiments about the government's investment in basic services and thereby suggest domestic policy priorities. A wide range of public sector entities with projects affecting the public can benefit from this use case application, including, but not limited to, the Ministries of Gender, Labour and Social Development, of Health and of Education and Sports, all of which run large-scale public projects. In addition, the Bank of Uganda, through the Uganda Bureau of Statistics, can monitor the sentiments of business communities through their social media pages and blogs, to determine customer perceptions of the business environment.

Public sector entities and all data producers must urgently build capacity for robust cybersecurity, to address fears of the data breaches and cyberattacks associated with open-data systems.

In as much as big data is a new and evolving phenomenon in Uganda, and to enable the country to realize the full benefits of big data adoption and utilization, steps should be taken to ensure that these suggestions lead to more in-depth discussions involving a broader group of stakeholders. When developing existing data strategies and implementation plans, participation should be leveraged. Collaboration between development partners already pushing for big data adoption and use in Uganda, including UN-CEBD, UNDP, Enabel and GIZ, is paramount.

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Annexes

Annex 1: Work plan for the assignment

TASKS	December 2024				January 2024				February 2024				Deliverables
	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	
Signing of Contract	■												
Compilation of the draft Inception presentation	■	■											
Finalization of inception report			■										
Revision of data collection tools based on inception meeting with the Project Management Team.			■										
Conduct rapid stakeholder analysis and initial review of secondary information from available reports		■	■	■									Deliverables 1 & 2: Inception report and Stakeholder Mapping Report
Meeting with Project Management team to approve Inception report and data collection tools				■									
Deploy self-assessment tools and conduct field visits to conduct key informant interviews at national level				■	■	■							

(continued)

TASKS	December 2024 Wk1	Wk2	Wk3	Wk4	January 2024 Wk1	Wk2	Wk3	Wk4	February 2024 Wk1	Wk2	Wk3	Wk4	Deliverables
Collation and analysis of quantitative and qualitative data from the field.							▓	▓					
Desk review of Big Data policies, sources, use cases and initiatives							▓	▓					
Benchmarking reviews of information from relevant reports							▓	▓					
Submit draft Baseline Assessment report									▓				
Meeting with Project Team members to Review Draft Baseline Assessment report									▓	▓			Deliverable 3: Final Baseline Assessment Report
Present or facilitate a validation workshop for the draft findings of the Baseline Assessment Report.										▓			
Incorporate feedback from the validation meeting and write final report based on comments received										▓			
Submit the final baseline assessment report										▓			
Meeting with Education Institutions to draft the Big Data Training Curriculum										▓			Deliverable 4: Capacity Building Assessment Report
Finalize and Submit Big Data Training Curriculum										▓			

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(continued)

TASKS	December 2024				January 2024				February 2024				Deliverables
	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	
Meeting with Project Team members to review final report and Implementation framework											▓		Deliverables 5, 6 & 7: Final Report, Implementation Framework and Full Set of weekly update reports
Present the final implementation review report to dissemination workshop for approval, including Implementation framework											▓		
Prepare and submit the final assignment report with the implementation framework including power point presentations											▓	▓	

Annex 2: Stakeholder Assessment Tool

Name of Stakeholder (Organization/Company): _____

Name of person being interviewed: _____ Designation: _____

Date: ___/___/_____ City/Town: _____

Introduction:

I am an ITU Big Data Landscape Assessment Expert, supporting the Ugandan Government's Big Data Development Project and I am conducting an analytical stakeholder assessment to explore the opinions of several important actors who are interested in the improvement of the Big Data landscape in the country. As an important player in this sector, we must obtain your opinion(s) and that of your organization.

We plan to conduct several interviews to produce a general report on the opinions of the major actors. The information obtained through these interviews will be for the direct use of the assessment team and will be presented in a general report to ITU, without identifying individual opinions.

We would now like to ask you a few specific questions about your opinion regarding the potential implementation of the Big Data Development Project.

Your Opinion:

1) If you don't mind, I would love to understand what you do about implementation and use of Big in this country?

2) What are the potential benefits to you and your organization/business of the Big Data Development project or any other Big Data initiatives in the country that you are aware of?

3) How do you think the project interventions could affect you both negatively and positively?

   a) Positively:

   b) Negatively:

4) What are the key constraints that you (and possibly others) face in the adoption and usage of Big Data?

5) What would be the solutions to your challenges mentioned above?

6) What role do you think the Big Data Development Project should play in the country?

7) How would you advise them to do it?

8) What is your current opinion of Big Data adoption, usage, and related programs in Uganda? What is your information based on / Who has influenced your opinion generally? *Note. Tease out if some of these influencers therefore become important stakeholders in their own right.*

9) How would you contribute to and work with this upcoming project? Probe for which of the three aspects of the project they'd support. a) Technological support, b) Capacity development c) Policy and regulatory support. What conditions would have to exist for you to express this support? Would you ally with any other persons or organizations in these actions? Which persons / organizations are these?

10) Are there something(s) that can hinder you from supporting the project? If yes, what are they?

11) What other organizations, departments within an organization or persons do you think would collaborate with / benefit from the project? *(Probe for key stakeholders)*

Annex 3: Big Data: Adoption and Usage Assessment Tool

This questionnaire is designed to understand the extent of usage of big data analytics as a business Time intelligence tool in decision-making and the factors influencing its usage. Please give appropriate responses in the questionnaire about your organization's use/not use of big data analytics. It is highly encouraged that you discuss this as a management and IT team before harmonizing your responses

Section (A) General Information

In this section, you are expected to respond to the following items related to the firm/organization where you work

1) What is your Job Title in the firm/organization? ……………………………..

2) What is the age of your firm/organization?

   1 – 5 years [ ]   6 – 10 years [ ]   11 – 15 years [ ]   16 – 20 years [ ]   Over 20 years [ ]

3) Please specify the size of your firm/organization in terms of employees.

   <100 employees [ ] 100 – 1 000 employees [ ] 1 001 – 10 000 employees [ ] >10 000 [ ]

4) Are you familiar with Big Data?

   Yes [ ]   No [ ]

5) If your answer to (4) is NO Go to (14), otherwise if YES GO to (8)

6) Has your firm/organization adopted Big Data Analytics?

   Yes [ ]   No [ ]

7) In which year did your firm start using Big Data in Uganda? ……………………………..

SECTION (B)

In this section, you are expected to respond to the following items related to your firm's/ organization's usage of Big Data Analytics.

8) To which level has your firm adopted, institutionalized, and used Big Data Analytics in your institution in Uganda?

   Initial Stages of Adoption (Considering/Planning adoption) [ ], Advanced Stages of Adoption (Testing/Piloting) [ ], Initial Stages of Usage [ ], Advanced/Effectively Using BDA [ ]

9) Which of these Big Data Analytics technologies/software have been adopted by your Firm/ Organization? You may choose more than one item.

   Relational Data Bases e.g. (ORACLE, DB2, etc.) [ ], Business Intelligence Tools [ ], Hadoop [ ], Map Reduce [ ], In-Memory Platforms [ ], Other Open-Source Technologies [ ], NoSQL databases [ ], Don't Know/Unsure [ ]

   Others Specify …………………..

10) Specify the total amount of data managed by your firm/organization

   Less than 100 Gigabytes (GB) [ ], 100 GB to 1 Terabyte (TB) [ ], 1 TB to 5 TB [ ], 5 TB to 10 TB [ ], 10 TB to 100 TB [ ], 100 TB + [ ]

Others Specify …………………..

11) Specify which of the following data types are being collected and analyzed by your firm/ organization. You may choose more than one item

Transactional data [ ], Social Media data [ ], Sensor data [ ], Multimedia data [ ] Spatial data [ ], Archived/historical data [ ], Mobile data [ ], Voice data [ ]

Others Specify …………………..

12) The rate of your firm/organization's usage of Big Data Analytics is very low

Yes [ ]   No [ ]   Don't Know [ ]

13) The rate of your firm/organization's usage of Big Data Analytics is very high

Yes [ ]   No [ ]   Don't Know [ ]

14) Does your firm have a department or unit responsible for Big Data Analytics?

Yes [ ]   No [ ]   Don't Know [ ]

SECTION (C)

The following statements relate to the factors affecting the adoption of big data analytics. Please [√] tick in the appropriate boxes to indicate the extent to which you agree with each statement as having influenced your adoption of big data analytics by your firm/organization.

STATEMENTS	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Technological Factors					
Relative advantage: Using big data analytics provides many benefits to the firm/organization which are better than those of the idea it supersedes e.g. BDA will reduce costs.					
Technical compatibility: The characteristics of big data analytics are consistent with the existing IT architecture in the organization (e.g., scalability, and integration into the existing information systems).					
Simplicity/complexity: It is easy to use and implement Big Data Analytics technology.					
Data security: customer information is a major barrier to the implementation of big data analytics.					
Organizational Factors					
Top Management Support: Top management supports the implementation of big data analytics as a business innovation for competitive advantage by availing resources					
IT/Technological infrastructure: The firm has the right infrastructure, technical skills, and IT platform to implement big data analytics technology					

(continued)

STATEMENTS	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Organizational Skills and Expertise: The organization has the skilled human resources to adopt and use Big Data Analytics.					
Financial Investment Capability: The organization has the financial resources to adopt and use Big Data Analytics.					
Environmental Factors					
Industry Pressure/Competition: Competition in the industry has called for innovative ways of doing business					
Partner Pressure: The firm's partners have called for innovative ways of doing things.					
Government Pressure / Support: Government encouragement through provision of or access to Internet and digitization of services create an enabling environment for big data analytics technology.					

15) Would you or your firm want to learn more about Big Data and Big Data Analytics?

We thank you for your participation and wish you well!

Annex 4: Big Data Maturity Index Tool

This Big Data Maturity Matrix is a self-assessment tool aimed to help the organization understand the extent to which it has developed or implemented, in this instance, big data infrastructure and applications. It therefore aims to help the organization understand its level of "organizational maturity" concerning BD development and also to identify its strengths and weaknesses from which a development plan or road map may be concerning of

Contact person:

E-mail:

Telephone:

High-Level Maturity Matrix – set your desired target

The high-level Matrix sets out the main objectives within each dimension by level. This aims to provide an overview of the organization and may be used to set the desired target level within each dimension.

Dimensions	Levels			
	Pre-Foundation	Foundation	Practitioner	Expert
Legal & Policy Framework	The organisation (or another Government department) is starting to consider the requirements for and the development of a Legal Framework for access to and the sharing of nontraditional/big data at the organisation. Discussions may have commenced to consider disclosure control, policies and sanctions for misuse, data acquisition powers, and the IP and Copy Right requirements.	Legislation is not yet in place, but work has commenced to develop reference documents that outline how nontraditional/big data should be disclosed. A permissible gateway is in place for third parties to share data with the organisation, and agreements are recorded. The organisation uses clear statements in its communications regarding IP and Copy Rights.	The organisation has a policy or guidance in place, for the use of non-traditional/big data although these are not required by Law. Statutory powers are in place that require some third parties to share data with the organisation, and it is registered and adheres to local Laws of IP and Copy Rights.	The organisation is required by Law to have policy or guidance in place. It has a reference document in place that outlines all nontraditional/big data sources and associated disclosure rules. Statutory powers are in place that require all big-data providers to share data with the organisation and it is registered and adheres to International Laws of IP and Copy Rights.

(continued)

Dimensions	Levels			
	Pre-Foundation	Foundation	Practitioner	Expert
IT Infrastructure	The organization is starting to consider the required IT infrastructure. It does not yet have dedicated big data infrastructure (or access to it if it is external to the organisation) for working with non-traditional/big data sources. Computing power and storage is limited. Processes and tools for non-traditional/big data work are developed fresh for each project. There are no data security measures in place for the import/export of big data. The data is not widely accessible to all within the organisation.	Projects using nontraditional/big data at the organisation may have localized infrastructure which is not integrated with normal operations (e.g. localized Hadoop or Spark applications). The reuse of some processes/tools may occur, but not in a readily accessible format. Security improvements may have been made for the import/export of data, although these may be inconsistent. Gaining access to the big data within the organisation may not be clear. Alternatively, the organisation may be in the process of agreeing access to the required infrastructure which is available externally to the organisation.	There is a dedicated big-data infrastructure at the organisation that has no limits to the size or complexity of the data, although some manual intervention may be required for deployment of the data. Alternatively, access to the external IT infrastructure is agreed and in place. A platform for analysis is in place with disaster recovery. Processes and tools are created once for multiple use across the organisation. Data security measures are in place for the import and export of big data and members of staff/analysts can access the data through a centralized request process.	The dedicated/acquired big-data infrastructure is scalable and can cope with increasingly complex projects. A mature development process is established that uses code and data pipelines for regular statistical processes. Data security and confidentiality is fully integrated, and analysts can access the data easily as part of normal operations.

(continued)

Dimensions	Levels			
	Pre-Foundation	Foundation	Practitioner	Expert
Human Resources	There is currently little awareness of big data analytics at the organisation, but senior managers have started to discuss and consider the requirements, in terms of human resources plus the associated financial requirements. It is starting to map out the big data posts that will be required and possible external expertise in this field for project delivery and/or advice. It is developing plans for recruiting and/or developing the skills within the organisation.	Big data awareness is growing within the organisation and a plan for big data positions is being developed. The mechanisms for how to recruit and build big data/data science skills are being put in place. The organisation may rely heavily on external big data expertise at this level. Some analysts may be experimenting with and practicing the use of big data.	Most of the organisation is aware of the benefits of big data analytics. The Recruitment strategy is in place and people are in big data posts, within teams. Capability building, and knowledge sharing is underway. Where required, the organisation may draw on external resources and/or support to aid big data capability building, although some internal training delivery may be established.	The culture for big data analytics is well established at the organisation and has become a normal consideration when undertaking research projects. A Big Data / Data Science profession (or job family) is defined within the organisation. There is an internal pipeline being developed to take on future big data roles, as the organisation increasingly relies on internal expertise for its big data analytics project work. All departments across the organisation work together to enhance and adopt big data approaches. The organisation may offer its expertise to others through, for example, the delivery of training, consultancy, mentorship and / or advocacy.

(continued)

Dimensions	Levels			
	Pre-Foundation	Foundation	Practitioner	Expert
Application	Big data tasks may be undertaken ad hoc by individual employees, out of their own self-interest. The organisation has not developed procedures for obtaining, processing and sharing big data but it is investigating this. The solutions developed as part of the tasks are not generally implemented into the statistical production. The internal exchange of knowledge and information about subcontracting activities does not exist. The implementation of tasks from planning and analysis of big data is done on non-advanced office packages.	Big data tasks are rare but may sometimes be undertaken by teams appointed to carry them out. The procedures for acquiring, processing and sharing big data are created only for the needs of the team's task. The teams operate in an uncoordinated manner, and the solutions developed by them could be implemented into production to a limited extent. Information and knowledge exchange are carried out only within the team and between team leaders. The implementation of the task does not significantly affect the development of knowledge about big data in the organisation. The tools used at work are adjusted only to the achievement of the main goal of the task.	Big data tasks are carried out by teams constantly operating within the organization. The team may have been recruited specifically for big data tasks at the organisation or is compiled of staff from different parts of the organization. Within the organization there are procedures for handling big data. The solutions developed by the team are implemented by the organisation. Knowledge exchange takes place between the big data team and the unit responsible for the implementation of big data tasks. Theoretical and practical knowledge resulting from the tasks performed is distributed within the organisation. The implementation of tasks is based on scalable tools that can also be used for other similar tasks.	The big data unit has a permanent place in the structure of the organization. Tasks are performed systematically and may involve other units within the organization, or externally. The solutions developed as part of the task are implemented and the methods applied to other statistical operations. Knowledge of big data tasks is widely spread throughout the organization. The organization's knowledge of big data activities is monitored on an ongoing basis. The organisation concludes on an ongoing basis from the tasks performed and problems arising. On their basis appropriate solutions are developed. The organization possesses a wide range of tools that can be used for new tasks.

(continued)

Detailed Questions to establish the current level within the Maturity Matrix

A. Legal & Policy Framework Dimension

The questions below will allow you to reflect on your Big Data Legal Practices and Policies. Please complete it as honestly as you can. We recommend that you answer the questions with the Legal Department to ensure accuracy and strategic buy-in.

Questions	Answers by Level				
	Pre-Foundation	Foundation	Practitioner	Expert
1. How would you describe the status of the Policies or guidance you have governing the handling of Big Data/Non-traditional sources?	The organization's current policies do not adequately describe how nontraditional/big data should be used and disclosed.	We are not required by legislation to have a policy or guidance in place, but we are in the process of developing a reference document that describes how non-traditional and/or big data should be used and disclosed.	We are required by legislation to have policy or guidance and we are in the process of developing a reference document that describes how non-traditional and/or big data should be managed, used and disclosed.	We are required by legislation to have a policy or guidance in place and a Reference document is in place that outlines the list of nontraditional and/or big data and how they should be used and disclosed in different contexts.
2. How would you describe the organization's adherence to policy/guidance?	The current policies/guidance/sanctions do not adequately address the misuse of nontraditional/big data.	We are developing a Policy or guidance for the misuse of non-traditional/big data.	We have a Policy or guidance in place but there are no sanctions in law for violations of these.	We have a Policy or guidance in place and there are sanctions in law for violations of these.
3. How would you describe the legal considerations for the disclosure of Data at your organisation?	There are no legal constraints for the disclosure of identifiable information; we may disclose identifiable information for any purpose.	We may disclose identifiable information for statistical purposes.	We may disclose identifiable information for statistical purposes only under certain controlled circumstances (e.g. for a considered 'safe' person, or for use within a 'safe' setting).	We are prohibited by law from disclosing identifiable data to anyone for any purpose and may only release no identifiable data-sets.

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(continued)

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
4. How would you describe your Partnership & Agreements practices?	We have limited or no statutory data acquisition powers and therefore any data acquisition is done through mutual agreement and by other national laws, e.g. Data Protection.	There is a permissive gateway for third parties to share data with the organisation which we use to acquire data. Sharing agreements are recorded and linked to existing non-traditional and/or big datasets.	We have statutory powers to require some third parties to share data with the organisation.	We have statutory powers to require all non-traditional and/or big data providers (private, public, international) to share data with the organisation.
5. How would you describe your Intellectual Property & Copy rights of Big Data?	The organisation is discussing or considering the adherence to IP & Copy Right requirements for nontraditional and/or big data.	There is a clear statement in the communication channels regarding IP & Copy Right of non-traditional and/or big data.	The organisation has registered and adheres to Local Laws of IP & Copy rights that include nontraditional and/or big data.	The organisation has registered and adheres to International Laws of IP & Copy rights that include nontraditional and/or big data.

(continued)

B. Information Technology Infrastructure Dimension

The questions below will allow you to reflect on your IT infrastructure and resources vis-à-vis big data utilization. We recommend that you answer the questions with the IT Department to ensure accuracy and strategic buy-in. Whether the storage is hosted internally or externally does not affect maturity level.

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
1. How would you describe computing power and data hosting at your organisation?	Big data projects do not have dedicated infrastructure, but rather use existing resources. Big data computing power and storage capacity is severely affected and limited due to lack of dedicated resources.	Big data projects may have their infrastructure, but it may not scale well or may constrain the scope of projects. Some specialized big-data infrastructure is used (e.g. a Hadoop or Spark cluster), but it is not tightly integrated with normal operations. There are backups, but they may not be tested regularly.	There is a dedicated big-data IT infrastructure that does not limit the size or complexity of current big data operations. Deployment may require manual intervention. Big data is stored and analysed on specialized infrastructure, with developed disaster recovery.	The dedicated big-data IT infrastructure is designed to scale with increasingly complex projects and big data is it an integral part of IT operations? Infrastructure deployment and computer resource provisioning can be automated.
2. How would you describe the processes and tools used in big data projects at your organisation?	Processes and tools used in big data projects are created fresh each time on non-advanced office packages. There is no specific big-data deployment process, or an existing data warehouse is used. All configuration is performed manually.	The tools used are often adjusted only for the big data project/task. The processes and tools that are reused are often extensive configuration requirements or versions. Infrastructure status may require manual checks. May have deployment code stored online.	A development process is in place to prevent the need to create new processes and tools for new projects, and they are generally designed for scalability and reuse. Infrastructure status is monitored and measured.	The organization possesses a wide range of tools that can be used for new tasks. Code, data configuration, and processes are designed for reusability, as part of a mature software-development process. Infrastructure teams manage system configuration in version control. All configuration is performed through code and data pipelines.

(continued)

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
3. How would you describe the security of the data import/export processes at your organisation?	The data import/export processes used for big data do not integrate security measures specific to big data concerns.	The data import/export processes may be modified to increase security and/or confidentiality of data, but it may be ad hoc or inconsistent.	Big data (or its derived datasets) is accessed and/or imported and exported in a systematic fashion that ensures the security and confidentiality of data.	Security and confidentiality are integral to the big-data strategy, and the organization is continuously looking for ways to improve it.
4. How would you describe the accessibility to big data and related applications?	Only IT staff can access the data and applications, or analysts access them on an ad hoc basis.	Analysts and application users either are unsure how to get the data or access the applications, or each has their method for accessing the data they need.	Analysts need to use multiple processes and/or make a service request to access the data.	Analysts have straightforward access to the data and use it as a part of their normal operations.
5. How would you describe the data governance practices for big data at your organisation?	Any control over data publication, retention, or adherence to contractual limitations on data use is performed manually.	Any control over data publication, retention, or adherence to contractual limitations on data use requires manual configuration of settings or case-by-case management.	Control over data publication, retention, or adherence to contractual limitations on data use may have some automation or external controls, or automation of policies. Reproducibility may therefore be limited.	Data publication and sharing is confirmed independently before publication, while ensuring control of data. There is robust automation of policies on deriving data, ability to set individualized policies on datasets, and dissemination criteria. It is clear how or whether results can be replicated.

(continued)

C. Human Resources Dimension

The questions below will let you reflect on your Human Resources practices regarding big data/data science posts and skills. We recommend that you answer the questions with the Human Resources Department to ensure accuracy and strategic buy-in.

Questions	Answers by Level				
	Pre-Foundation	Foundation	Practitioner	Expert	
1. How would you describe the awareness of nontraditional/big data sources within your organisation?	There is currently little awareness of non-traditional/big data sources at the organisation, although senior managers are discussing it more frequently.	Awareness of non-traditional/big data sources is growing within the organisation, especially through IT practitioners, analysts and their senior managers.	Most of the organisation understands how non-traditional/big data analytics can benefit outputs.	The culture for the use of non-traditional/big data sources is well established and adopted as a normal consideration when undertaking research projects at the organisation.	
2. How would you describe your organisational structure with regards to non-traditional/big data/ data science posts?	The organisation is starting to consider and discuss what is needed in terms of nontraditional/big data/ data science positions at the organisation.	A plan for non-traditional/ big data/data science positions is being developed by the organisation and is planning where posts should be placed and how to fill them.	Non-traditional/big data/ data science positions are present within the organisation and feature in the regular organisational business planning process.	Posts are well established, and succession plans are in place for more senior positions. A big data/data science job family is defined within the organisation.	
3. How would you describe current big data/data science skills within the organisation?	Big data/data science skills are present *ad hoc* within the organisation.	Some analysts are developing new skills for the extraction, transformation, linkage, and analysis of big data. Some may also be developing knowledge of big data programming tools such as R and/or Python.	Big data analytics and data science techniques are well established. Project findings, methodologies and code are readily shared across the organisation for knowledge exchange.	Big data/data science skills and techniques are very well established. Research papers, methodologies and findings are presented nationally and internationally via journals and conferences.	

(continued)

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
4. How would you describe the acquisition of in house/ outsourced big data/data science expertise for project delivery?	The organisation is discussing the possibilities for acquiring big data/data science expertise for project delivery.	The organisation is drawing mainly on external resources to aid big data/data science project delivery. Internal staff are encouraged to participate to aid knowledge exchange.	The organisation draws on both internal and external expertise for big data/data science project delivery. Knowledge exchange to internal staff is fully enabled through well managed collaborative projects and research.	The organisation uses mainly internal resources for the delivery of big data/data science projects. Internal team collaboration is commonplace, aiding knowledge exchange and the development/growth of internal staff. External collaborations continue, with two-way knowledge exchange well established.
5. How would you describe the availability of big data/data science training courses at the organisation?	There are currently no training opportunities at the organisation to develop employees in the field of big data/data science.	The organisation commissions others to provide training for employees in the field of data science/big data.	The organisation is building internal training resources for internal delivery. Training may be delivered by those who have already acquired new skills at the organisation, by an external provider, or by a dedicated data science trainer.	The organisation has established the resources and materials for the internal delivery of training. Formal programmes of assessed training are established via emerging collaborations with universities, coaching and learning centers, or others. The organisation is capable of offering big data/data science training, consultancy, guidance and mentorship externally to other organisations.

(continued)

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
6. How would you describe your big data/data science recruitment processes?	The organisation is discussing the processes required for big data/data science recruitment.	Big data/data science recruitment processes are being established by the organisation that include a simple assessment of technical competencies.	Big data/data science recruitment processes are established by the organisation that include a good assessment of technical competencies against an appropriate competency Framework.	Well-defined recruitment processes are in place that use robust assessments of technical competencies against an appropriate Competency Framework, using approaches such as a presentation of project case studies or assignments. The organisation may offer advice and templates to others who are seeking advice on how to recruit for data science posts.

(continued)

D. Application Dimension

The questions below will allow you to reflect on the application of big data/data science within your organisation. We recommend that you answer the questions with the Senior Management Team to ensure accuracy and strategic buy-in.

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
1. Who carries out big data tasks/projects in the organisation?	Big data tasks/projects may not yet be happening, although Individual analysts within the organisation have started to become interested.	Ad hoc groups of analysts appointed to carry out a single big data task.	Permanent teams have been established to carry out specific tasks. They are activated when they are needed.	Units responsible for implementing big data tasks have a permanent place in the organization's structure. They are likely to engage and/or collaborate with the rest of the organisation to help with the delivery of organisational objectives.
2. How are big data tasks/ projects carried out in the organisation?	Where big data tasks are undertaken, they may be very uncoordinated, initiated by individuals at the organisation out of their own interest.	Big data tasks/projects are still uncoordinated, but they may now be requested (e.g. by a manager). They may feed into localized business needs or interests.	Big data tasks/ projects are stoically coordinated and effectively contribute to wider organisational objectives.	Tasks are performed systematically. The dedicated team can work collaboratively with other units within the organization, or with other departments or organizations to help others meet their organisational objectives.
3. How would you describe the procedures that have been developed about acquiring, processing and sharing big data in the organisation?	The organisation has not developed procedures for obtaining, processing or sharing big data.	The procedures for acquiring, processing and sharing big data are created only for the needs of the team's tasks (they may be contractual, do not affect the functioning of the organization).	Within the organization, the procedures for handling big data are documented and are being applied.	The implementation of big data tasks within the organization is incorporated into the regular procedures.

(continued)

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
4. How would you describe the implementation of big data solutions into the statistical production process at the organisation?	The solutions developed as part of the tasks are not implemented in statistical production.	Solutions developed by a team of experts could be implemented into production.	The solutions developed by a team of experts are implemented in the entire scope of statistical production.	The solutions developed as part of the task are implemented and the methods applied to other statistical operations.
5. How would you describe the process of integrating project results with the organisations resources?	Big Data resulting from project undertakings are not integrated with other data sources held at the organisation. The organisation has not developed methods and techniques for big data integration with other data-sets.	Big Data sources are integrated with other data sources held at the organisation for the needs of individual tasks/projects. Data integration is temporary. New databases are redundant with limited metadata.	The integration of big data with other data sources is permanent. The developed methodological and technical solutions allow for constant data integration with other data sources held by the organisation. Databases have complete and consistent metadata.	Full data integration with other data sources held by the organisation takes place. Data is constantly monitored and adapted to emerging changes.
6. How are the results of the big data research projects disseminated?	The results are not shared outside of the organisation, but they may be disseminated to a narrow audience within the organisation. No documentation has been developed and made available as part of the big data tasks/projects carried out.	The results are shared outside of the organisation in the form of experimental statistics. Limited documentation is made available as part of the tasks / projects (e.g. methodological assumptions, user guide).	The results are published outside of the organisation in the form of single publications related to the topic. As part of the tasks/projects carried out, full documentation (e.g. technical - source codes, processing algorithms, information on data flows) is made available.	The results are published regularly. They can be accompanied by additional analyses and interpretative comments by the authors. There are reports published about how progress is made and the planned implementation.

(continued)

Questions	Answers by Level			
	Pre-Foundation	Foundation	Practitioner	Expert
7. How is information from big data projects shared within or outside the organization?	The internal exchange of knowledge and information about subcontracting activities does not exist.	Information and knowledge exchange are carried out only within the team and between team leaders.	Knowledge exchange takes place across the organisation, sharing project findings, methodologies and code.	Knowledge of big data tasks is widely spread throughout the organization. Research papers, methodologies and findings are presented nationally and internationally via blogs and/or conferences.

Tick the appropriate box for each Intervention area, in terms of importance to be implemented by the Big Data Development Project (where 1 = Least Important and 5 = Most Important)

	Strategic intervention	Importance rating				
		1	2	3	4	5
1	Enhance Big Data (BD) usage policy reforms					
2	Strengthen the capacity of institutions to effectively apply or use BD					
3	Strengthen coordination and partnerships among all stake-holders for the effective implementation of BDA					
4	Enhance political commitment by Government leaders to push for relevant organizations to adopt BDA					
5	Scale up the application of BDA in the various Public and Private Sector Organizations					

LESSONS LEARNED AND BEST PRACTICES

Based on your experiences, what are the lessons learned and key best practices that can be used to improve any Big Data Development Project in the country to achieve its intended objectives?

CLOSING QUESTION

Is there anything that we did not ask but in your view is significant, please do share

Annex 5: Training Needs/Competency Assessment Tool

This Competency Framework and its tool sets out an extensive set of skills and knowledge that the UN Global Working Group (GWG) Task Team for Competencies, Training and Capacity Development considers useful for acquiring and processing big data. It is not a requirement that each data specialist must possess all of them. The framework is intended to provide general guidance for the organization, for use when hiring, assessing knowledge gaps, and training staff in specific areas. This will help the organization to achieve their strategic business goals, now and in the future. It is fully recognized that different organizations will be running different projects, in different thematic areas. They will also have different types of data specialist, e.g. data analyst, data engineer, data scientists, etc., and each will require different compositions of skills and knowledge.

Dimension 1			
Name of the area	Ethics and privacy		
Proficiency Level Dimensions	A – Foundation	B – Intermediate	C – Advanced
Proficiency Levels Description	Demonstrate knowledge and understanding of basic rules of philosophical, and legal of collecting, processing, and sharing big data.	Demonstrate knowledge, under-standing, and putting into prac-tice philosophical, legal, and technical rules of collecting, processing, and sharing big data.	Thorough knowledge of the application of personal data protec-tion law, proficiency in personal data manage-ment and skillfulness in performing operations on varied data sets respect-ing the law, and ethical norms while maintaining the highest technical stan-dards. Advises others on the ethical and privacy considerations of data.
Please tick below the proficiency level that best describes you	Do you understand the ethical basis for managing large customer data sets?		

Knowledge, Skills, and Attitude Questions for Ethics

Knowledge Assess-ment Questions	• Do you know the rules for the processing of personal data? Y/N • Do you understand the ethical basis of managing large customer data sets? Y/N • Can you describe the advantages and disadvantages of the use of record-level data to achieve business purposes? Y/N
Skills Assessment Questions	• Are you able to develop a method of collecting, storing, and sharing data by law regulations and ethical standards in the organi-zation? Y/N • Are you able to assess whether the acquired data sets have personal data that allow the identification of units? Y/N • Can you describe and use software that protects data against uncontrolled disclosure? Y/N

(continued)

Dimension 1	
Name of the area	Ethics and privacy
Attitude Assessment Questions	• Do you have a pragmatic view of the impact of personal data regulations on the lives of people and organizations? Y/N • Do you have critical thinking around ethics? Y/N • Do you possess a good understanding and acceptance of rights between data owner and data explorer? • Are you aware of the responsibility for the use of private data? Y/N • Are you aware of the disclosure control methods if outputs are identifiable? Y/N

Dimension 2		
Name of the area	Mathematics	
Proficiency Level Dimensions	A – Foundation	B – Intermediate	C – Advanced
Proficiency Levels Description	Demonstrate knowledge and understanding of algebra.	Demonstrate knowledge and understanding of algebra and methods, and ability to apply some of them.	Thorough knowledge of algebra, and skillfulness in performing operations on varied data sets. Can advise others on the possible solutions and application of methods to problems.
Please tick the proficiency level that best describes you			

Knowledge, Skills, and Attitude Questions for Mathematics

Knowledge Assessment Questions	• Do you know the rules for creating matrices? Y/N • Do you Know sentence logic and first-order logic? Y/N • Can you describe the theoretical basis of probability theories? Y/N
Skills Assessment Questions	• Can you carry out operations on matrices (addition, scalar multiplication, and transposition)? Y/N • Able to study the basic properties of functions and relations? Y/N • Able to indicate classes of equivalence relations abstraction? Y/N
Attitude Assessment Questions	• Are you prepared for independent study of connection issues in mathematics language? Y/N • Do you understand the significant limitations in defining concepts and mathematical attitudes? Y/N

Dimension 3			
Name of the area	**Data management**		
Proficiency Level Dimensions	A – Foundation	B – Intermediate	C – Advanced
Proficiency Levels Descriptions	Demonstrate knowledge and understanding of basic data management skills.	Demonstrate knowledge and understanding of database management tools and methods, and ability to apply some of them.	Thorough knowledge of and proficiency in database management and skillfulness in performing operations on varied data sets. Can advise others on finding data management solutions.
Please tick the proficiency level that best describes you			

Knowledge, Skills, and Attitude Questions for Data Management

Knowledge Assessment Questions	• Do you know the basic concept of SQL and NoSQL databases (such as table, column, row, field, field, type, primary and foreign key, relations)? Y/N • Do you understand the consequences of using the hash function? Y/N • Do you know the basic elements of the SQL language? Y/N • Can you define the functional dependencies occurring among the analysed data? Y/N • Can you describe the existing database and indicate the appropriate transition keys for the use of official statistics? Y/N • Can you describe the advantages and disadvantages of a dataset in various formats? Y/N
Skills Assessment Questions	• Are you able to create database structures in selected database management systems (e.g. MySQL, MongoDB, etc.)? Y/N • Are you able to select the most used method of going deeper through all the binary tree nodes? Y/N • Are you able to present the logical structure of the database using tables and graphical relationships in selected programs (e.g. MS Access, HBase, etc.)? Y/N • Are you able to place and search for specific information in the database? Y/N • Can you use simple administrative tasks related to databases, e.g. backing up structures and the data itself? Y/N • Are you able to apply queries to relational and non-reactive databases? Y/N • Are you able to apply ETL techniques - acquisition, processing (including pre-purification), and loading data from non-statistical sources? Y/N

(continued)

Dimension 3	
Name of the area	**Data management**
Attitude Assessment Questions	• Can you systematically supplement knowledge of new trends in the field of computer science on the subject of computer data storage? Y/N • Can you identify data sources and assess their usefulness in complementing the studies at hand? Y/N • Can you carefully analyse the data and adjust it to the needs of database users? Y/N • Can you use metadata to clarify data processing? Y/N • Are you aware of logged data import, export, edit, and processes? Y/N

Dimension 4			
Name of the area	**Statistics**		
Proficiency Level Dimensions	A – Foundation	B – Intermediate	C – Advanced
Proficiency Levels Descriptions	Demonstrate knowledge and understanding of underlying assumptions of at least two of the above-listed areas/techniques.	Demonstrate knowledge, understanding of underlying assumptions and ability to apply at least four of the above-listed techniques.	Demonstrate knowledge and understanding of underlying assumptions in your area of expertise as well as, more generally, in other statistical areas. Can advise others and use a network of contacts to ensure that the most appropriate methodology is applied.
Please tick the proficiency level that best describes you			

Knowledge, Skills and Attitude Questions for Statistics

Knowledge Assessment Questions	• Do you understand the theoretical basis of analysis of variance (e.g. ANOVA)? Y/N • Can you describe the assumptions underlying logistic regression? Y/N • Do you understand the consequences of the assumptions not holding? Y/N • Can you depict the expected output of factor analysis? Y/N

(continued)

Dimension 4	
Name of the area	**Statistics**
Skills Assessment Questions	• Can you compare selected statistical methods and specify differences between them? Y/N • Can you select the most relevant statistical method for a specific analytical problem? Y/N • Can you deploy the most relevant statistical technique for a specific data set and analytical problem? Y/N • Can you effectively and accurately interpret statistical outputs? Y/N
Attitude Assessment Questions	• Can you Identify new statistical needs and develop statistical analyses to meet them? Y/N • Can you provide critique of statistical analyses produced or received? Y/N • Can you give guidance on selecting data sources and matching them with relevant statistical techniques to meet the analysis goals? Y/N

Dimension 5		
Name of the area	**Machine Learning (ML)**	
Proficiency Level Dimensions	A – Foundation	B – Intermediate	C – Advanced
Proficiency Levels Descriptions	Demonstrate knowledge and understanding underlying assumptions of basic probability theories and most common statistical methods and machine learning techniques, programming skills in one of the ML-related applications.	Demonstrate knowledge and understanding of applying probability theories and variety of statistical methods and machine learning techniques. May have developed further programming skills in at least two of the packages and ability to apply them to resolve ML-related analytical problem.	Demonstrate knowledge, understanding of probability theories and most of the statistical methods and a variety of ML techniques. Shows the ability to apply various ML techniques in various scenarios and advises and leads others. Have the knowledge and skills to fit the ML solution into a product/ service system.
Knowledge, Skills and Attitude Questions for Machine Learning		
Knowledge Assessment Questions	• Do you understand Bayes rules? Y/N • Do you understand the assumptions underlying model evaluation (quality) indicators, e.g. accuracy, recall, F1 score? Y/N • Do you understand the differences between neural networks and SVM? Y/N		

(continued)

Dimension 5	
Name of the area	**Machine Learning (ML)**
Skills Assessment Questions	• Can you develop a statistical model and fit relevant ML techniques to the analytical problem at hand (e.g. classification and coding, data edition and imputation, image recognition optimization process)? • Can you apply adequate model evaluation indicators?
Attitude Assessment Questions	• Can you proactively search for optimization opportunities in statistical production with the use of ML • Monitor predictive performance of the employed model to ensure its quality control, being up to date and ability to generate valid results

Dimension 6			
Name of the area	**Programming**		
Proficiency Level Dimensions	A – Foundation	B – Intermediate	C - Advanced
Proficiency Levels Descriptions	Demonstrate knowledge and understanding of the basic functionalities of analysis tools with graphical interfaces	Apply the appropriate programs, tools and perform intermediate operations (loading, editing, saving, exporting data) Use of built-in functions or define own function (UDFs) and perform factor analysis.	Demonstrate knowledge and understanding of the advanced functionality of selected tools. In working with data, use advanced functionalities of libraries and packages. Able to advise others on the best tool to use for the job at hand.
Please tick the proficiency level that best describes you			
Knowledge, Skills and Attitude Questions for Programming			
Knowledge Assessment Questions	• Do you know the types of queries used in relational databases? Y/N • Do you understand the differences between sorts of data structures: vectors, matrices, arrays, factors, lists, data frames? Y/N • Can you describe the functionality of selected libraries and packages in Python, R? Y/N • Can you depict the expected output of factor analysis? Y/N		

(continued)

Dimension 6	
Name of the area	Programming
Skills Assessment Questions	• Can you upload, edit, save and export data using Python and R programming language? Y/N • Can you develop and create a relational database using dedicated programs? Y/N • Can you deploy a selected library or package for in-depth data analysis? Y/N • Can you obtain data for R package, determine their quality, build and graphically present the model? Y/N
Attitude Assessment Questions	• Can you automate processes related to the development of raw statistical data? Y/N • Can you discover dedicated libraries to facilitate statistical analysis with various file formats? Y/N • Can you systematically increase knowledge related to the technical process in coding practices to build scalable digital products? Y/N • Can you use version control platforms to assist with collaboration? Y/N • Do you understand the need to expand technological knowledge to improve the skills of using new computer tools? Y/N

Dimension 7			
Name of the area	Data visualization		
Proficiency Level Dimensions	A - Foundation	B – Intermediate	C - Advanced
Proficiency Levels Descriptions	General knowledge of visual solutions related to big data Programming skills to develop simple visual representation of the data (e.g. charts, graphs, box plots, histograms, info-graphics). Good understanding of when to use which graph.	Demonstrate knowledge of specific visual solutions related to big data Programming skills to apply a selection of more complex visual methods (e.g. area chart, bubble cloud, heat map, tree-map, word cloud) and an understanding of when to apply which visual method.	Thorough knowledge of visual solutions related to big data Programming skills to deploy a wide array of appropriate visual methods. General knowledge of graphic design, color regimes applicable in certain domains (e.g. map making). Able to advise others on the most appropriate data visualization tool to apply.
Please tick the proficiency level that best describes you			

Knowledge, Skills and Attitude Questions for Data Visualization

(continued)

Dimension 7	
Name of the area	Data visualization
Knowledge Assessment Questions	• Do you understand trigonometric functions and their relation to data visualization? Y/N • Do you understand graph theory? Y/N • Do you understand visualization functions of analysis software? Y/N • Do you understand color regime in maps development? Y/N
Skills Assessment Questions	• Can you prepare data sets for visualization purposes? Y/N • Can you generate a heat map? Y/N • Can you apply adequate visualization technique to the data/analytical output at hand? Y/N • Are you able to simplify complex theories/data through visualization? Y/N
Attitude Assessment Questions	• Can you proactively search for the most attractive, up to date and yet clear visualization techniques? Y/N • Can you critically assess the match between the target audience and the purpose of the information to be presented to utilize the most adequate visualization forms? Y/N • Can you proactively explore new data visualization techniques and packages to enhance data presentation? Y/N

Annex 6: Policies, Legislation, Strategies and Frameworks related to BD application

Outstanding elements for action	Strategic Direction/Summary/Objectives/Goals
Digital Uganda Vison Policy	Is a National Policy and Strategic Framework that reviews, integrates, consolidates, and improves all the existing ICT strategies, policies and plans into one overarching digital Vision for Uganda by providing a unified direction for ICT development and an Integrated ICT project implementation approach. The principal aim of Digital Uganda Vision is to align ICT investments in the various sectors in a manner that will improve the country's Global ICT indices for purposes of attracting investors. The ministry will define digital milestones to avert duplication and ensure agglomeration benefits from the investments in ICT's.
National ICT Policy 2003	The overall goal of the Policy is to "promote the development and effective utilization of ICT such that quantifiable impact is achieved throughout the country within the next 10 years." This is to be achieved through dedicated legislation; improved education; opportunities for citizens and institutions to gain access to and disseminate information; enhancing the country's economic, social and intellectual potential; and by eliminating digital divide.
Rural Communications Development Fund (RCDF) Policy 2010/11 – 2014/15 (**Under review**)	The Policy aims at increasing the coverage of communications facilities and services to more underserved areas and people of Uganda and also to deliberately enhance the usage of ICT services in the country.
The National Broadband Policy 2018	The policy prioritizes broadband infrastructure among other public utility infrastructure plans (water, transport and energy), and mainstream it into all sectors of the economy.
The National Postal Policy (2012)	To develop and maintain a nationwide postal infrastructure that meets the industrial, commercial, public, social and household postal communications needs of the country.
The Analogue to Digital Migration Policy (2011)	The policy goal is to achieve efficient and effective utilization of Radio Spectrum in line with internationally agreed guidelines; the purpose is to provide a framework that will facilitate a smooth transition from analogue to digital terrestrial broadcasting.
The National E-waste Management Policy (2012) (**Under review**)	This policy aims to guide, promote and ensure the safe management of E-waste in Uganda and contribute to reduction of environmental degradation by mitigating.
The National Country Code Top Level Domain Policy (2013) (**Under review**)	The major objective of this policy is to formalize management of Uganda Country Code Top Level Domain Name and come up with a management framework that will ensure transparency and greater accountability towards the Internet community of Uganda and the rest of the Global Internet Community.

(continued)

Outstanding elements for action	Strategic Direction/Summary/Objectives/Goals
The Broadcasting Policy 2008 **(needs to be retired)**	Uganda has a national aspiration for modernizing development sectors by the year 2025. It embodies strategic actions, which will guide government policies over the next twenty years. Given the strategic actions of the Vision 2025 and the national development objectives embedded in the current broad framework, this policy embraces: i) A balance between freedom of the press and the social responsibility of the media; ii) Convergence of technologies; iii) Ugandans' control and ownership of the broadcast media and signal distribution; iv) An appropriate legal and regulatory framework, which takes into account the present trends of the media industry and its future developments; and v) A responsible electronic media which serves the interest of all stakeholders.
e-Government Interoperability Framework (e-GIF)	The GoU Interoperability Framework (e-GIF) is the agreed approach to the delivery of GoU public services in an interoperable manner. It defines basic interoperability guidelines in the form of common principles, models, and recommendations.
e-Government Interoperability Reference Architecture (GIRA)	The GIRA is an architecture content meta-model defining the most salient architectural building blocks needed to build interoperable e-Government systems. The GIRA provides a common terminology that can be used by people working for public administrations in various architecture and system development tasks.
NITA-U Strategic Plan 2018/19 – 2022/23	The Plan transitions NITA-U from an IT infrastructure based model to an IT service delivery model and these are the goals: • fit legislative processes to the digital age; • re-engineer ICT legislation; • coordinate the digital transformation process; • re-engineer public services; • perceive data and information as a public asset; • implement digital government enablers; • make Uganda digitally skilled; • implement emerging technologies; • ensure connectivity for all; • ensure broadband coverage; • protect personal and business data defend cyber-space from cyber-attacks.

(continued)

Outstanding elements for action	Strategic Direction/Summary/Objectives/Goals
Cybersecurity Strategy 2021	The Cybersecurity Strategy 2021 is a strategic planning tool that reflects Uganda's plans to achieve the objectives of modern economies. The strategy contributes to existing policies that seek to implement Uganda's socio-economic development from a cybersecurity perspective and aspires to support building a digital environment that citizens and businesses can trust.
GoU e-Government Web Application Security Architecture Framework.	Web Application Security Architecture (WASA) Framework is an approach to protect the information processed by Uganda e-Government e-services by securing the underlying web applications. Designing security deeply into the technical solutions, the WASA helps to counter fight cyber threats such as system compromise and data leakage.
National Information Technology Authority, Uganda (NITA–U) ACT, 2009	Objective: • To provide high-quality information technology services to Government; • To promote standardization in the planning, acquisition, implementation, delivery, support and maintenance of information technology equipment and services, to ensure uniformity in quality, adequacy and reliability of information technology usage throughout Uganda; • To provide guidance and other assistance as may be required to other users and providers of information technology; • To promote cooperation, coordination, and rationalization among users and providers of information technology at the national and local level to avoid duplication of efforts and ensure optimal utilization of scarce resources; • To promote and be the focal point of cooperation for information technology users and providers at regional and international levels; and to promote access to and utilization of IT by the special interest groups.

(continued)

Outstanding elements for action	Strategic Direction/Summary/Objectives/Goals
The Electronic Transactions Act, 2011.	This provides for the use, security, facilitation and regulation of electronic communications and transactions; encourages the use of e-Government services and provides for related matters: • The Act creates a light-handed regulatory regime for electronic transactions. • It facilitates the development of e-commerce in Uganda by broadly removing existing legal impediments that may prevent a person from transacting electronically because of omission in the traditional laws. • It makes provision for functional equivalence; thus, paper transactions and electronic transactions are treated equally before the law. • Establishes rules that validate and recognizes contracts formed through electronic means. • Sets default rules for contract formation and governance of electronic contract performance. • Defines the characteristics of a valid electronic writing and an original document. • Supports the admission of computer evidence in courts and arbitration proceedings.
The Electronic Signatures Act, 2011. (Aligned to changes under the GoU e-Government Web Application Security Architecture Framework)	This makes provision for and regulating the use of electronic signatures and provide for other related matters; • The Act makes provision for the use of electronic signatures to ensure that transactions are carried out in a secure environment. • It establishes a public key infrastructure for authenticity and security of documents • Recognizes the different signature creating technologies • Provides effective administrative structures e.g., establishment of Certification Authorities
Data Protection and Privacy Act 2019. (Aligned to changes under the GoU e-Government Web Application Security Architecture Framework)	The objective of the Act is to protect the privacy of individuals by regulating the collection and processing of personal information in Uganda and outside Uganda if the information relates to Ugandan citizens; to provide for the rights of the persons whose data is collected and the obligations of data collectors, data processors and data controllers; as well as to regulate the use or disclosure of personal information.
The Computer Misuse Act 2011	An act to make provision for the safety and security of electronic transactions and information systems; to prevent unlawful access, abuse or misuse of information systems including computers and to make provision for security the conduct of electronic transactions in a trustworthy electronic environment and to provide for other related matters.

(continued)

Outstanding elements for action	Strategic Direction/Summary/Objectives/Goals
Access To Information Act, 2005	The purpose of this Act is: • to promote an efficient, effective, transparent and accountable Government; • to give effect to article 41 of the Constitution by providing the right to access to information held by organs of the State, other than exempt records and information; • to protect persons disclosing evidence of contravention of the law, maladministration or corruption in Government bodies; • to promote transparency and accountability in all organs of the State by providing the public with timely, accessible and accurate information; and to empower the public to effectively scrutinize and participate in Government decisions that affect them.
The Uganda Communications Act, 2013.	The objectives of this Act are to develop a modern communications sector, which includes telecommunications, broadcasting, radio communications, postal communications, data communication and infrastructure.
Copyright and Neighboring Rights Act, 2006.	The Act spells out how one obtains a copyright or neighboring right, what qualifies to be protected. it also provides for how protected works may be exploited by third parties; the duration of the rights protected; and creates offences for infringement.
Electronic Media Act, 2000	This Act provides for the setting up of a broadcasting council to license and regulate radio and television stations, to provide for the licensing of television sets, to amend and consolidate the law relating to electronic media and to provide for other related matters.
The National Payment Act 2020	This act seeks to bridge this gap by providing for the safety and efficiency of payment systems; the regulation of payment systems, payment service providers and the issuance of electronic money, among others. The Act provides for the central bank as the regulator, supervisor, and overseer of the operations of payment systems to ensure their safety and efficiency.
The Electronic Media Statute, 1996	The Statute created a licensing system, under the Broadcasting Council, for radio and television stations, cinemas, and videotape rental businesses. The purchase, use, and sale of television sets was also to be subject to licensing by the Council.
The Press and Journalist Statute, 1995	The Statute extended Article 29(1) (Freedom of expression) of the Constitution to the print media. It also created the Media Council, the National Institute of Journalists of Uganda and a Disciplinary Committee within the Media Council. The Council is responsible for regulating eligibility for media ownership and requires journalists to register with the National Institute of Journalists of Uganda.

(continued)

Outstanding elements for action	Strategic Direction/Summary/Objectives/Goals
The National Information Technology Authority, Uganda (E-Government) Regulations, 2015.	The National Information Technology Authority, Uganda shall promote the establishment and maintenance of inter-operable information systems within public bodies.
The National Information Technology Authority, Uganda (Certification of Providers of Information Technology Products and Services) Regulations, 2016	Certification of Providers of Information Technology Products and Services.
The National Information Technology Authority, Uganda (Authentication of Information Technology Training) Regulations, 2016.	In conjunction with the ministry responsible for education to be the authentication center for information technology training.
The Electronic Transactions Regulations, 2013.	The purpose of the Regulations is to operationalize the Electronic Signatures Act (ESA). The Regulations provide further detail to the Electronic Signatures Act (ESA) about licensing and recognition of Certification Service Providers (CSPs); providers of Repository Services and Date and Time Stamp Services. They also set out the roles, responsibilities and obligations of the various service providers and players in the e-signature's environment; provide for handling of complaints and resolution of disputes that may arise between the players and lay down offences and penalties for failing to adhere to the Regulations.
National Identification and Registration Authority (NIRA)	The Registration of Persons Act, 2015 established the National Identification and Registration Authority (NIRA) and tasked the authority to: i) Create, manage, maintain and operate the National Identification Register. ii) Register citizens and non-citizens who are lawfully resident in Uganda.
Certification of Providers of IT Products and Services. (NITA-U Regulation)	Provides for IT Training Services (Companies and Individuals) as indicated in the attendant Regulations.
The Data Protection and Privacy Regulations, 2020	The Regulations seek to empower individuals to take control of their data and to support organizations with their lawful processing of personal data.
The Electronic Signatures Regulations, 2013	The purpose of the Regulations is to operationalize the Electronic Signatures Act (ESA). The Regulations provide further detail to the Electronic Signatures Act (ESA) about licensing and recognition of Certification Service Providers (CSPs); providers of Repository Services and Date and Time Stamp Services.

Annex 7: Selected portfolio of Government Systems for Data Management

Table 9: Selected portfolio of Government systems for Data Management

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
ACCOUNT- ABILITY	Bank Of Uganda	Central Securities Depository (CSD)	Facilitates the management and trading of government securities by financial institutions	No
		BOU Banking System (BBS)	Core banking system intended to improve service delivery to the bank customers through the automation of banking operations	No
		Electronic Clearing System (ECS)	Facilitates the inter-bank clearing of low-value payment instruments which include cheques and EFTs	No
	Capital Markets Authority	Licensing and approvals	Enable CMA to license various capital markets players to assist the public in making capital markets investments.	No
	Financial Intelligence Authority	GO-Anti money-laundering system	To monitor and enforce anti-money laundering operations	No
	Inspector General of Government	E-Service to Report Corruption, Available on the e-citizens portal	Report corruption online	No
	Inspector General of Government	Online declaration system (ODS)	Online wealth declaration system for public servants	No
	Insurance Regulatory Authority (IRA)	IRA online licensing System. E-service, Available on the e-citizens portal	Online service to apply for a license online	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/Application	Main function/Business Processes	Big Data Adoption Verified
	Microfinance Support Centre	Solomon enterprise resource planning system (ERP)	Enterprise resource planning system	No
	Ministry of Finance, Planning and Economic Development	Integrated financial management system (IFMS)	Financial management across Government	No
	Ministry of Finance, Planning and Economic Development	PBS Performance Budgeting system)	Budgeting for Government MDA/LGS	No
	Ministry of Finance, Planning and Economic Development	DMFAS (Debt Management and Financial Analysis system)	Facilitate budget preparation for central MDGA/LGS	No
	Ministry of Finance, Planning and Economic Development	Foreign missions' financial management system	The system used to enhance budget preparation and execution, accounting and financial reporting	No
	National Planning Authority (NPA)	Geographic information system for Physical Planning	Provide maps/data to that facilitate planning	No
	National Social Security Fund	National Pension system	The system used to manage all pensions	No
	Public Procurement and Disposal of Public Assets Authority (PPDA)	Electronic government procurement (e-GP)	End to end online government procurement	No
	Uganda Revenue Authority	ASYCUDA World	International trade facilitation	No
	Uganda Revenue Authority	E-TAX system	Domestic Tax Management information system	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
	Uganda Revenue Authority / Uganda Communications Commission	Telecommunications Intelligent Monitoring System (TIMS)	Monitors Telecom Traffic (International, One Network Area and National Traffic), Mobile Money, Automated Revenue Monitoring System (ARMS) and Anti-Fraud Management (i.e., Telecoms bypass fraud).	Yes
	Uganda Revenue Authority	Electronic cargo tracking	Tracking Cargo in transit	In process
AGRICULTURE	Ministry of Agriculture	E-certification system	System to provide sanitary systems to importers, certify agricultural traders	No
	Ministry of Agriculture	Geo-portal	Geo-information	No
	Ministry of Agriculture	A web-based livestock market information system (LMIS)	A web-based livestock market information system (LMIS)	No
	Ministry of Agriculture	Food Security and Nutrition Information System	Food security information	In process
	Ministry of Agriculture	Agricultural statistical database and database tools	Collect, manipulate, disseminate agricultural- based information	No
	National Agricultural Advisory Services (NAADS)	EIA Database and online EIA	EIA Review, Permit and licensing, Inspection and compliance enforcement	No
ENVIRONMENT	NEMA	EIA and permit Printing System	Electronic printing of certificates	No
	NEMA	Online ESIA assessment	Online environmental impact assessments	No
	NEMA	Online tracking of EIA review progress	To speed EIA review and tracking projects progress on assessment	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
AGRICULTURE	Uganda Coffee Development Authority	Profiling of sustainable coffee	Determine the source of sustainable coffee(location)	No
	Uganda Coffee Development Authority	Geographical information system	Establish the physical location of the coffee farms	No
	Uganda Coffee Development Authority	Registration of coffee farmers	Establish acreage and number of coffee trees	No
	MAAIF & Uganda National Meteorology Authority (UNMA)	The Automatic Weather prediction system	Automatic Weather prediction system to manage information collected by the equipment to be used with MAAIF	In Process
EDUCATION	Ministry of Education and Sports	E-management information system (EMIS)	Used to manage information within the education sector	No but with potential
	Ministry of Education and Sports	Teacher Management Information System (TMIS)	Used to collect data on teacher/teaching performance, including attendance	No but with potential
	National Curriculum Development Centre	Examinations information management system	System used to register students, process results and produce transcripts and certificates	No
	Uganda National Examinations Board (UNEB)	UNEB ERP	Enterprise resource management system	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
ENERGY & DEV'T	Petroleum Authority	National information petroleum information system (NPIS)	Information management system for petroleum business operations.	No
	Ministry of Energy	Power sector information system (PWIS)	Information management system for entire sector	No
	Ministry of Energy	Crane Management System (National supplier database)	Contains information on contractors, surveys, procurements, GIS data, also has an HR module.	No
	Rural Electrification Agency (REA)	SharePoint	Document and collaboration tool	No
	Rural Electrification Agency (REA)	SCADA	Used to monitor power outages	No
	Uganda Electricity Distribution Company Ltd (UEDCL)	Net View System	Manages network	No
	Uganda Electricity Generation Company Ltd (UEGCL)	Microsoft Navision 2016 ERP	Finance and accounting, fixed assets and procurement	No
	Uganda Electricity Transmission Company Ltd (UETCL)	Supervisory control and data acquisition (SCADA) Fleet management system – road based	Human machine interface, data acquisition management Fleet and vehicle monitoring and management	No No
	Uganda Electricity Transmission Company Ltd (UETCL)	Geo-vision video management system	CCTV monitoring and management	No but with potential

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
HEALTH	Ministry of Health	DHIS2	Reporting system for management – statistics etc.	No but with potential
	Ministry of Health	Community Health Management system	Android based platform providing diagnostic support and case management	No but with potential
	Ministry of Health	Family connect	SMS/USSD based platform that sends expectant mothers and heads of households two life-cycle-based SMS/ week.	In Process
	Ministry of Health	MTrac	Digital, real-time surveillance tool at facility level that sends weekly disease surveillance data via SMS.	In Process
	Ministry of Health	Electronic Medical Records System (EMR)	Advanced system designed to steamline patient management, clinical documentation and reporting within health care facilities	In process
	Ministry of Health	Health management information system (HMIS)	Integrated reporting system used to collect and monitor the health sector strategic and investment plan (HSSIP) indicators	No
	Ministry of Health/ National Council for Science and Technology	Clinical Research Information Management System	Regulation of clinical research in Uganda	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
	National Drug Authority	Drug registration, application	Application and registration of drugs	
	National Drug Authority	NDAMIS (https:// portal.nda.or.ug/)	Premises Module, Products Module, Import/export Module, GMP Module, Inspection Module	No
	National Drug Authority	Web Ordering System (ARV and Drugs) – NMS, JMS and MAUL – integrated into HMIS system	Order for HIV commodities, including ARVS, TB medicine and laboratory reagent.	No
	National Medical Stores	MACS	Warehouse and logistics management system	No
	National Medical Stores	Enterprise resource planning management system	Enterprise resource planning management system	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
	Uganda AIDS Commission (UAC)	National HIV database Situation room	To define the who, what and where of HIV & AIDS prevention, treatment and care stakeholders in Uganda The situation room is an interactive software platform which enables government and other authorities to effectively use the HIV data sets (e.g. Epidemiological, service delivery, logistic information, community data) in real-time for decision-making.	No
	Uganda AIDS Commission (UAC)	Gender Indicator Dashboard	System to monitor and track gender indicators in the National HIV/AIDS Strategic Plan, OVCMIS and GARPR	No
	Uganda Blood Bank Transfusion Services	Blood bank information systems UHI patient DB access system	Information management system for information on blood availability, stock and laboratory management. Record management system: with e- messaging: SMS to remind patients.	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/Application	Main function/Business Processes	Big Data Adoption Verified
ICT	Government Citizen Interaction Center (GCIC)	Innovators application portal	Portal for innovators to apply for procurements under the innovation fund	No
	MoICT&NG	IAC online booking tool	Used to manage the calendar for the information access center (locally hosted)	No
	MoICT&NG	Parish Development Model Information System (PDMIS)	Used to collect parish data across Uganda to be used by all partnering institutions to track all Parish Development model data	In Process
	NITA-U	MDA contact database ITCO	Customer relationship database for all MDAS Registry of certified IT professionals	No
	NITA-U	Unified Messaging and Collaboration System	Unified Messaging and Communications System (UMCS) will avail unified messaging/E-mail, VoIP, instant messaging to users across Government	No
	Posta Uganda Limited	Archiving system	Archiving and document management	No
	UCC			Yes
INVESTMENT	Uganda Investment Authority (UIA)	Electronic Business Portal (eBiz) National SME Portal	An integrated electronic one-stop portal to issue business-centric licenses and services to investors and the business community. An online SME registration and performance tracking system	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
JLOS	Directorate of Public Prosecution (DPP)	PROCAMIS (Prosecution and Case Management Information System)	Information system to manage reported cases	No
	Judiciary	Justice centers MIS	Recording court cases details	No
	Judiciary	Court case administration system (CCAS)	Capture and reporting on court case information	No
	Judiciary	Integrated electronic court case administration system	Capture and reporting on court case information across all entities in the sector; Prisons, Police, DPP, etc.	No
GENDER AND SOCIAL DEVELOPMENT	Ministry of Gender, Labour and Social Development	External labour management information systems	Online system for labour exportation opportunities	No
	Ministry of Gender, Labour and Social Development	National gender-based violence database	Online database for reporting GBV services at national level	No
	Ministry of Gender, Labour and Social Development	Case management information system-	Automated business processes (management of cases)	No
	Ministry of Gender, Labour and Social Development	OVCMIS	Automated business processes for identification of vulnerable children at national and district level	No
	Ministry of Gender, Labour and Social Development	Remand Homes Management Information system (RHMIS) is an	IT e Government System for Monitoring activities and welfare of children in the Remand Homes in Uganda.	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
SECURITY	Ministry of Internal Affairs	E-Visa	Enable online visa applications, special passes, work permits and identification of individuals	No
	Ministry of Internal Affairs	Community service database	Manages offenders; those who have committed crimes which are minimal and can conduct community service as punishment	No
	Ministry of Internal Affairs	DGAL system	For specialized analytical and forensic investigation	No
	Ministry of Internal Affairs	National Counter Trafficking database	Captures details of citizens and used across borders for identify criminals wanted and human trafficking	No
	Ministry of Internal Affairs	E-registry	Reduce on paper usage, efficiency through a simplified document workflow	No
	Ministry of Internal Affairs	E-passport	Registration, application and processing for passports. Helps to detect counterfeit or manipulated documents	No
	Ministry of Internal Affairs	AG system (Administrator General System)	Electronically Documenting Estates of the Deceased, Children, Date of Death, Widows/Widowers, and Property (Debts and Credits Inclusive)	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
JUSTICE & HUMAN RIGHTS	Ministry of Justice and Constitutional Affairs (MOJCA)	DCL case management system	Manages ministry court cases from inception to closure	No
	Ministry of Justice and Constitutional Affairs (MOJCA)	DLAS information management system	Helps in contract management and file collaboration within the directorate	No
	National Identification and Registration Authority	National identification register	Contain biodata for citizens	No
	Uganda Human Rights Commission(UHRC)	Human rights integrated information system (HURIS)	Registration of human rights violations	No
	Uganda Human Rights Commission(UHRC)	Crime records management system (CRMS)	Crime records management	No
POLICE	Uganda Police Force	Suspects profile systems	Monitoring suspects in cells	No
	Uganda Police Force	Fingerprint system	Captures fingerprints of all criminals	No
	Uganda Police Force	Private Security Information and management system	Manages Private security companies' infrastructure: e.g. Number of guns, deployment and license	No
	Uganda Police Force	CCTV Surveillance System.	Manages real-time traffic and mobility data to support monitoring of criminal activity	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
	Uganda Police Force	E-vehicle check system	Database for stolen Vehicles	No
	Uganda Police Force	CCTV Surveillance System	Monitoring activities on urban and peri-urban roads and selected residential areas	No
	Uganda Police Force	Prisons management system	Information management system to support automation of processes	No
	Uganda Prisons	EDMS	Electronic document management system	No
REGISTRATION	Uganda Registration Services Bureau(URSB)	E-licensing portal	Online licensing services to MDAS and citizens/businesses	No
	Uganda Registration Services Bureau(URSB)	Land information system(s)	Registration and management of land transactions	No
LANDS	Ministry of Lands, Housing and Urban Development (MoLHUD)	Online land searches	Online land searches	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
PUBLIC SECTOR ADMINISTRA-TION	Ministry of Foreign Affairs	Protocol information management system	Managing e-visa application, tax system for diplomats	No
	State House	An EDMS system	Data administration of the institution	No
	Public service commission	E-recruitment system	Web application to register profiles of health workers, to receive submissions and applications for recruitment online. This web application is accessible remotely in HSC regional hubs, in regional referral hospitals	No
	Health Service Commission	Human resource management system	Human resource management modules	No
	Kampala Capital City Authority	E-CITIES	Financial management, revenue collection and registration of property and taxi operators	No
	Kampala Capital City Authority	LOGICS (Local Government Information and Communication System)	Monitor the money provided by the government to the Local governments and assess the performance	No
	Ministry of Local Government (MoLG)	Local government revenue management information system	Financial management	No
	Ministry of Public Service	Integrated personal payroll system (IPPS)	Human resource management, payroll and retirement benefits	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/Application	Main function/Business Processes	Big Data Adoption Verified
	Office of First Parliamentary Counsel	Prime minister's integrated management information system (PIMIS)	Monitoring performance of gov't projects	No
	Office of the Prime Minister	Northern Uganda Social Action Fund (NUSAF) management information system	Information system to track NUSAF project operations	No
	Office of the Prime Minister	Online Monitoring of Government Programmes	Online service for citizens to monitor government programmes	No
	Office of the Prime Minister	Prime ministers' dashboard	Government performance scorecard	No
	Office of the Prime Minister	Refugees MIS	Identification and management of Refugees	No
	Kampala Capital City Authority	E-CITIES	Financial management, revenue collection and registration of property and taxi operators	No
	Kampala Capital City Authority	LOGICS (Local Government Information and Communication System)	Monitor the money provided by the government to the Local governments and assess the performance	No
	Ministry of Local Government (MoLG)	Local government revenue management information system	Financial management	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
	Ministry of Public Service	Integrated personal payroll system (IPPS)	Human resource management, payroll and retirement benefits	No
	Office of First Parliamentary Counsel	Prime minister's integrated management information system (PIMIS)	Monitoring performance of gov't projects	No
	Office of the Prime Minister	Northern Uganda Social Action Fund (NUSAF) management information system	Information system to track NUSAF project operations	No
	Office of the Prime Minister	Online Monitoring of Government Programmes	Online service for citizens to monitor government programmes	No
	Office of the Prime Minister	Prime ministers' dashboard	Government performance scorecard	No
	Office of the Prime Minister	Refugees MIS	Identification and management of Refugees	No
	Office of the Prime Minister	Government evaluation facility system	Government evaluations repository	No
	Office of the Prime Minister	National Emergency Coordination and Operation Centre (NECOC) MIS	Disaster Monitoring and Early warning systems	No
	Parliament of Uganda	Quick statistics and summary report system (UGSTATS)	Disseminate statistical information	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/Application	Main function/Business Processes	Big Data Adoption Verified
	Uganda Bureau of statistics	UBOS app	Disseminate statistical information	No
	Uganda Bureau of statistics	UBOS ARCGIS online	Disseminate statistical information	No
	Uganda Bureau of statistics	UBOS GEONODE platform	Disseminate statistical information	No
	Uganda Bureau of statistics	The online performance information monitoring system	The online performance information monitoring system	No
	Uganda Tourism Board	Tourism enterprises database	Allows tourism companies to register their businesses/establishments	No
	Uganda Wildlife Authority	Billing and card management system	Billing management system	No
	Uganda Wildlife Authority	Online tourist payments	Cashless systems payment for accessing services in the national parks	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
TRADE & INDUSTRY	Ministry of East African Community Affairs	E-single window	Online application for export registration, preferential certificate of origin by exporters and online tracking of customs document status	No
	Ministry of Trade, Industry and Cooperatives (MTIC)	Cooperatives Registry Management Information System	Provides information on the details of registered cooperative societies in the country. It's use ranges from registration to management of cooperative societies at the Ministry	No
	Uganda Exports Promotion Board	Laboratory information management system	Provides information on chemical, electrical, microbiological, materials and engineering laboratory	No
	Uganda National Bureau of Standards	Certification information management system	Provides information on certifications, standards, catalogues etc.	No
	Uganda National Bureau of Standards	E-Portal (imports inspection and clearance information management system)	Online services, application for inspections and clearance	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
WATER & ENVIRONMENT	Ministry of Water & Environment	Water billing system	Enable customer payments for services offered by the ministry	No
	Ministry of Water & Environment	Water information system	Store information on location, the technology used to provide water and status.	No
	Ministry of Water & Environment	National water supply database	A web-based repository of the national water sources data	No
	Ministry of Water & Environment	Water management zones knowledge-base	Water resources data	No
	Ministry of Water & Environment	Geographical information system	For mapping resources	No
	Ministry of Water & Environment	Rural and Urban Management Information System (RUMIS)	A new mWater based system for regularly tracking water service levels in the country	No
	National Forestry Authority	GIS and Online revenue management system	To manage internal revenues online	No
	National Water and Sewage Cooperation	NWSC Billing system	Water customers water bilcustomers' flight information	No

Table 9: Selected portfolio of Government systems for Data Management (continued)

SECTOR	Name of MDA	Name of System/ Application	Main function/Business Processes	Big Data Adoption Verified
WORKS & TRANSPORT	Civil Aviation Authority	Aviation control system	Provide automated aviation control	No
	Ministry of Works and Transport (MoWT)	Computerized driving permit	Used to process driving permits	No
	Ministry of Works and Transport	The Vehicle operator licensing system	The management system used for licensing information	No
	Ministry of Works and Transport	Road Safety Monitoring System	Report on road accidents.	No
	Ministry of works and transport	Intelligent Transport Monitoring System (ITMS)	The new management system used for electronically registering all vehicles through issuance of number plates.	Not yet
	UNRA	Project management solution (IFMS ERP)	Enterprise Resource Planning system	No
	Ministry of works and transport	Registry for authorized vehicle contractors	Registry for authorized vehicle contractors	No

Annex 8: Proposed Implementation Framework (Pillars and Initiatives)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
1 Data Foundations and Governance	1.1 Ensure better adherence to current legal and regulatory frameworks for data protection regulations	Increased adherence to legal and regulatory frameworks related to use of big data	1.1.1 Support MDAs with no data governance frameworks to develop in-house data governance frameworks (policies, guidelines, structure, roles and responsibilities etc.) 1.1.2 Review, update and strengthen existing relevant laws, policies and regulations (e.g. the draft Open Data Policy 2017 and the Access, Data Protection and Privacy Act 2019 etc.) 1.1.3 Develop a national data policy informed by best practices (e.g. AU data policy framework, EU digital service act, etc.) 1.1.4 Develop a flexible regulatory environment through the use of regulatory sandboxes 1.1.5 Recognize and reward enforcement of relevant data policies, laws, and regulation 1.1.6 Recognize and reward adherence to compliance to national data laws 1.1.7 Gradually obligate the use of existing (big)-data systems among public sector actors

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
	1.2 Create an environment that will encourage more investment and advancement in data structure	Increased funding for big-data initiatives	1.2.1 Conduct advocacy dialogues to increase budget allocations for domestic resources for strategic data initiatives 1.2.2 Mobilize funds from international development partners, multilateral organizations, and donor agencies to support the implementation of the BDUS 1.2.3 Foster collaboration between the public and private sectors through PPPs to co-finance big-data initiatives, e.g. by providing incentives, tax breaks, or other forms of financial support (align with the partner coordination processes in the digital transformation roadmap) 1.2.4 Establish digital platforms or marketplaces that facilitate the monetization of data assets and services, subject to adherence to ethical and privacy standards 1.2.5 Conduct a comprehensive data funding inventory or mapping exercise to catalog existing data-related funding sources, initiatives, and projects across government agencies, development partners, private sector entities, and civil society organizations 1.2.6 Align funding strategies, priorities, and investment criteria across different stakeholders to ensure coherence and consistency in resource allocation for data initiatives, especially among development partners 1.2.7 Establish platforms, repositories, or databases for sharing information on funding opportunities and project proposals among funders, donors, and implementing partners, to facilitate collaboration and coordination in data resource mobilization and implementation

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
	1.3 Develop models to guide organizations on the minimum standards required for data infrastructure	Increased organizational adherence to Data Infrastructure minimum standards	1.3.1 Implement big data components in existing data centers, starting with the NITA-U data center, such as Data Lake as a service. 1.3.2 Implement big data pilots to demonstrate contextualized successes to increase the use of data by government agencies in decision-making 1.3.3 Review, strengthen and use digital signature infrastructure (e.g. public key infrastructure) 1.3.4 Acquire appropriate infrastructure that facilitates timely data collection, processing, storage, sharing and use 1.3.5 Develop and strengthen data infrastructure, including data centers, cloud computing platforms, energy infrastructure, and high-speed internet connectivity, to support data transmission and exchange as well as data-intensive applications and services
	1.4 Put in place Data standardization mechanisms and provide assurance services for the big data ecosystem as well as data quality and eliminating barriers to data use	Improved big-data quality and usage	1.4.1 Standardize data formats, definitions, classifications (open, proprietary industry, private), and metadata to facilitate interoperability, consistency, and integration of data across different systems, organizations, and sectors 1.4.2 Synchronize and harmonize data collection procedures to reduce costs 1.4.3 Develop standards for data and metadata generation, storage, and sharing to minimize errors and inconsistencies 1.4.4 Standardize primary data registries as single sources of truth 1.4.5 Strengthen enforcement of data standardization guidelines 1.4.6 Proactively monitor and remediate data quality challenges

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
	1.5 To harmonize all national data in disparate locations for the purpose of effective management, improved public service delivery, and the creation of new business models and services	Improved harmonization of national data	1.5.1 Identification and analysis of fragmented national data. 1.5.2 Pilot harmonizing national data and hosting at NITA-U data centers 1.5.3 Connect government software applications to the harmonized data 1.5.4 Establish national data governance structures at national and agency levels to ensure coordination and collaboration between key stakeholders and partners 1.5.5 Establish regional coordination centers/working groups 1.5.6 Implement inter-institutional collaboration in the data governance framework 1.5.7 Create a coordination mechanism to ensure streamlining of development partner interventions in the digital economy sector 1.5.8 Create incentives and rewards for data sharing and collaboration among stakeholders, including businesses, research institutions, government agencies, and civil society organizations

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
2 Data Literacy and Skills. (Build a resilient data-driven ecosystem characterized by a culture of data utilization)	2.1 Integrate data literacy and skills into Uganda's educational system as a part of digital literacy and skills to build and enhance the skills over a significant number of gardens in data science, artificial intelligence, machine learning, deep learning and other big data related technologies	Big data-related skilling curriculum integrated in Uganda's education system and digital skilling programs	2.1.1 Design and implement tailored big-data literacy programmes targeting policy-makers, government officials, educators, students, and the general public 2.1.2 Work with national educational institutions (MoE, NCHE, and other educational bodies) to integrate data-related skills training into formal curricula across disciplines 2.1.3 Integrate big-data skills training into existing digital training initiatives, (e.g. the Digital Skilling Program) 2.1.4 Mainstream Data Science/ Analytics in public ICT schemes of service 2.1.5 Implement massive, advanced data skill development programs to build technical expertise in data analytics, big data and other data tools among government officials, researchers, analysts, and other relevant stakeholders to maximize the value of data 2.1.6 Build capacity in modern tools and technologies (including AI) to maximize the value of existing data 2.1.7 Establish a monitoring and evaluation mechanism on big data literacy and skills penetration in the country

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
	2.2 Raise awareness of the value of data as a national resource to produce new value	Increased awareness of big data value to improve big data use culture	2.2.1 Develop and implement awareness campaigns, educational programs, and communication initiatives (including through social media and traditional media) to raise awareness about the importance and benefits of big data-driven decision-making 2.2.2 Orient and promote leadership commitment and accountability in prioritizing big-data-driven approaches and initiatives at all levels of government, business, and civil society 2.2.3 Promote the adoption of innovative and all-inclusive data-driven planning and decision-making 2.2.4 Recognize and celebrate exemplary initiatives, projects, and individuals that demonstrate the transformative power of big-data-driven decision-making in driving positive change and achieving measurable impacts 2.2.5 Conduct cross-learning initiatives/exchange visits between MDAs with BD adopters/champions and those that are BD pre-foundation level
	2.3 Assess data literacy and skills required for various sectors in the country	Big Data Skills gap in various public sector areas determined and monitored	2.3.1 Conduct periodic Big Data competency assessments with relevant public sector ICT and Statistical cadres.
	2.4 Support the capacity building and training for civil servants and public servants in big data skills	Improved competencies in data science and other big data-related technologies among targeted public sector staff	2.4.1 Train relevant public sector staff in relevant big data-related technologies 2.4.2 Establish internship opportunities for Data Science related students at relevant MDAs where BD is / has been adopted

(continued)

	Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
3	Data Security, Privacy and Responsibility	3.1 Create, adopt, and modify data security policies, procedures, programs, and initiatives to improve data use and security in the public and private sectors	Improved big-data use and security in the public and private sector	3.1.1 Strengthen enforcement of existing policies and regulations on data protection and security 3.1.2 Operationalize and strengthen the Computer Emergency Response Teams (CERT) at both national and grassroots levels 3.1.3 Invest in and procure modern data security tools and technologies to mitigate cyber-security threats 3.1.4 Establish mechanisms for secure and compliant cross-border data transfers
		3.2 Ensure and promote the lawful, secure, fair and ethical, sustainable and accountable use of data in Uganda	Increased adoption of Secure, lawful and ethical data use practices	3.2.1 Conduct promotion drives of information security and data privacy in relevant organizations in Uganda 3.2.2 Roll out behavioral change communication messaging to the public on ethical and secure use of data

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
4 Data Access, Integration and Availability	4.1 Ensure that all fragmented National data sources are identified, analyzed and integrated using the shared Government Integration Platform to provide data to the public and private sector	Increased integration of National data sources in Uganda's public sector	4.1.1 Create a data-sharing framework that facilitates personal and non-personal data sharing between enterprises within the country 4.1.2 Review and strengthen the data integration platform as a national data-sharing infrastructure
	4.2 Ensure that the open data standards and guidelines are in place and implemented across government and the private sector	Increased compliance to open data standards and guidelines by Public and Private sector	4.2.1 Constitute an Open Data Governance Committee in Uganda 4.2.2 Develop National Open Data Guidelines and strategy, both for the Public and Private sector. 4.2.3 Support MDAs develop data management guidelines for both digital and non-digital data
	4.3 Ensure that cloud computing is adopted to increase access to data and reduce costs of operation	Increased access to data through clouding	4.3.1 Promote cloud computing services among MDAs that have not yet embraced it (59% of MDAs have adopted clouding)
	4.4 Provide an open data portal composed of data sets in machine-readable format from both the public, private sectors and civil society for further innovation and research	Increased availability of adequate, accurate and reliable information about the implementation of open data is available	4.4.1 Develop a national open data portal

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
5 Data Services and Innovation	5.1 Promote data-driven innovation, research, and digital services	Increased data-driven research and innovations realized	5.1.1 Provide online access to open data collected by the government, businesses, and individuals to academia and innovators to support R&D and innovation in BD applications 5.1.2 Provide research funding to support innovative research projects that leverage data to address priority areas such as healthcare, agriculture, education, and governance 5.1.3 Implement open data initiatives across government agencies to improve transparency and accountability, build trust between citizens and public agencies, and improve public service delivery 5.1.4 Promote/incentivize the availability and utilization of data in developing new products and services for commercial and social purposes 5.1.5 Protect IP arising from open data innovation. 5.1.6 Increase government uptake of locally developed data solutions
	5.2 Build the trust of citizens and other user groups within the data economy ecosystem	Improved trust of the citizens in the data eco-system	5.2.1 Encourage innovators to exploit open data in developing new data-driven solutions 5.2.2 Offer grants, tax incentives, and business development services to aspiring entrepreneurs and innovators to launch and grow big-data-driven ventures 5.2.3 Create big data sandbox to ensure compliance of big data, innovations with the country's data laws and regulations, and development of best practices 5.2.4 Support business data localization in critical competitive areas 5.2.5 Facilitate cross-border data flows to foster digital free trade

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
	5.3 Create plans and initiatives for the quick use of data in social, economic, and research and development endeavors	Increase data use in social, economic, research, and development endeavours	5.3.1 Establish data as an economic and social resource
	5.4 Establish data innovation spaces through the National ICT Innovation Hub to leverage technology and application developments as incubators for new businesses and for the development of skills, competence, and best practices	Increased utilization of data innovation spaces	5.4.1 Develop programs to promote competition in creating solutions through the application of Big Data
	5.5 Identify big data use cases in critical sectors for pilot implementation to explore the potential of big data	Increased implementation of big data use cases	5.5.1 Implement five practical use cases in NDP IV priority projects 5.5.2 Establish a robust monitoring and evaluation framework to assess the impact of the use cases and other data-driven initiatives

(continued)

Pillar	Sub-Pillar OR Strategic Objectives	Outcome	Initiatives
6 Data Sover-eignty and Equality	6.1 Ensure the existence of guidelines regarding compliance with the legal and regulatory framework for data use in Uganda	Increased compliance to Ugandan data laws	6.1.1 Recognize and reward enforcement to relevant data policies, laws, and regulations for Ugandan data (Related to Activity 1.1.7) 6.1.2 Recognize and reward adherence to compliance to national data laws 6.1.3 Classify and control access to data collected in Uganda and from Ugandans 6.1.4 Develop / strengthen data residency guidelines and their compliance with national laws and regulations 6.1.5 Regulate access to Ugan-da's strategic/sensitive data 6.1.6 Collaborate with other countries and international organizations to establish common standards and frame-works for data sovereignty
	6.2 Facilitate cross border flows of data	Increased cross border data flows	6.2.1 Develop guidelines to monitor cross border data flows and ensure protection of Ugandan data 6.2.2 Establish mechanisms for secure and compliant cross-border data transfers (Relate to activity 3.1.4)

Annex 9: Glossary of Key Terms

Term	Definition
Big data	Refers to the set of massive and complex data that cannot be managed with traditional processing tools. Applying advanced analytics to this data allows you to obtain insights and make informed decisions.
Digital transformation	It is the process of taking advantage of digital technologies to change and improve an organization's business models, processes, activities and experiences to adapt to the digital environment.
Artificial Intelligence	It is the simulation of human intelligence in machines to perform tasks such as voice recognition, decision making, machine learning and natural language understanding.
Data analytics	It is the process of examining, cleaning, transforming and modeling data with the aim of discovering useful information, patterns and trends that help with decision making.
Machine Learning	It is a branch of artificial intelligence that is based on algorithms and models that allow machines to learn from data and improve their performance through experience, without needing to be explicitly programmed.
Internet of Things (IoT)	It consists of the interconnection of everyday objects with sensors and electronic devices to collect and share data over the Internet, allowing automation and intelligent decision making.
Cloud computing	It is a model for delivering computing services through the network, which allows access to resources such as storage, servers and software through the Internet, without the need to have its own infrastructure.
Cyber-security	Refers to the measures and practices used to protect computer systems and data from threats, attacks and unauthorized access.
Blockchain	It is a distributed and decentralized registry technology that allows the verification and secure recording of transactions, eliminating the need for intermediaries and providing transparency and trust.
Data Producers	Data producers refer to any entities, processes, or systems that generate data. These can be people, sensors, machines, or software applications.
Data Consumers	Data Consumers refer to systems, individuals, or applications that use or analyse data after it has been collected, transformed, and stored. They play a crucial role in data-driven decision making, using the processed data to derive insights and create actionable strategies.

Annex 10: Big Data Maturity Assessment responses by MDA and Non MDA actors

	Legal and Policy Framework		Infrastructure		Human Resource		Application	
	MDAs	Non MDAs[1]	MDAs	Non MDAs	MDAs	Non MDAs	MDAs	Non MDAs
Pre Foundation	14	26	17	26	20	26	21	26
Foundation	6	9	4	9	1	9	2	9
Practitioner	2	2	2	1	2	1	0	1
Expert	1	0	0	1	0	1	0	1
TOTAL	**23**	**37**	**23**	**37**	**23**	**37**	**23**	**37**

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[1] The Telecommunications and Financial services sector were identified as the non-state sectors where BD has been promoted and hence were the ones assessed. 3 Telecommunication companies and 2 Commercial banks were directly assessed with all the 34 financial institutions secondarily assessed.

Annex 11: Big Data Competency Assessment responses by relevant MDA staff

	Ethics & Privacy	Mathematics	Data Management	Statistics	Machine Learning	Programming	Data Visualization
Advanced	0	4	0	4	0	2	1
Intermediate	10	6	10	6	3	5	2
Foundation	18	20	18	15	13	17	16
Pre-Foundation	7	5	7	10	19	11	16
TOTAL	35	35	35	35	35	35	35

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