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African Higher Education Leadership in Advancing Inclusive Innovation for Development / AHEAD

585919-EPP-1-2017-1-RO-EPPKA2-CBHE-JP

Analysis of the National Innovation System in Uganda



Makerere University, Lira University, Kyambogo University

Work Package 1.3

AHEAD

Inclusive Innovation
for Development

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Capacity Building in Higher Education

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Introduction

The Erasmus+ project “African Higher Education Leadership in Advancing Inclusive Innovation for Development / AHEAD” is implemented by a consortium of 15 institutions from Europe and East Africa, including:

- ▶ 4 Universities from Europe:
 - University of Medicine, Pharmacy, Sciences and Technology of Tîrgu Mures, Romania
 - Birmingham City University, the United Kingdom
 - University of Molise, Italy
 - University of Social Sciences, Polandjoined by the consultancy company European Center for Quality, Bulgaria

- ▶ 2 Universities from Tanzania:
 - Dar es Salaam Institute of Technology
 - The State University of Zanzibar

- ▶ 3 Universities from Uganda:
 - Kyambogo University
 - Lira University
 - Makerere University

- ▶ 5 Universities from Kenya:
 - Kenyatta University
 - Kibabii University
 - Kisii University
 - Mount Kenya University
 - The Catholic University of Eastern Africa

The project seeks to initiate a long-term partnership to mobilize EU expertise in support of building capacities of Kenyan, Tanzanian and Ugandan universities to lead and manage innovation that best fits their countries’ inclusive and sustainable development needs.

As part of the project work plan, partner universities from Kenya, Tanzania and Uganda carry out the analysis of the National Innovation System (NIS) in their countries. The implementation of this activity is based on the AHEAD Guidance and Benchmarking Tool for NIS analysis (WP 1.1). It aims to:

- ▶ help partner universities identify areas where National Innovation Systems in Kenya, Tanzania and Uganda are well-developed and where they are underperforming;
- ▶ assess the gaps in the performance between Kenya, Tanzania, Uganda and EU countries;
- ▶ develop recommendations for action and improvement;
- ▶ guide the planning of the upcoming project activities at partner universities.

The report on the Analysis of the National Innovation System in Uganda provides the necessary background knowledge of the context, in which the project capacity-building activities in Uganda will take place.



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I. Performance of the National Innovation System

1. Gross domestic expenditure on R&D

- ▶ Gross domestic expenditure on R&D (as percentage of GDP)

The Gross domestic expenditure on R&D as percentage of GDP for Uganda stands at 0.48 percent with most GERD by source funds coming from abroad (57.3%) followed by government that contributed 21.9 percent (UNESCO Institute for Statistics, 2014).

2. Business enterprise expenditure on R&D (BERD) and Government Sector expenditure on R&D (GERD)

- ▶ BERD as a percentage of GDP: **0.07%**
- ▶ GERD as a percentage of GDP: **0.11%**

Source: EAC (2017). East African Science and Technology Commission strategic plan 2017/18-2021/22. Time reference: 2014

3. Patents and licenses

- ▶ Royalty and license fees payments (per capita) – No data
- ▶ Royalty and license fees receipts (per capita) – No data
- ▶ IP filing activity originating in the country

Global patent filings grew by 8.3% and global trademark filing activity by 13.5% making for seven years of straight increases. Following an 8% decline in 2014 and 1% growth in 2015, industrial design filing activity rebounded strongly in 2016 with 8.3% growth (World Intellectual Property Indicators, 2017).

- ▶ Number of IP applications and grants

Patent applications by office and origin-2016 only totalled to 16 resident patents. In terms of Trademark registration class counts for offices of selected low and middle-income countries for 2016; Uganda had 2,094 non-resident registrations, an equivalent of 63.6 percent.

- ▶ Success rate of IP applications from locally-based individuals / companies (ratio of IP grants to the number of applications)

Data for this indicator is not available.

4. Scientific production

- ▶ Number of publications included in Scopus and Web of Science databases: **15,129**
- ▶ Scientific publications rated among the top 10% most cited: **No data**
- ▶ Number of scientific and technical journal articles: **No data**

5. Research capacity

- ▶ Number of researchers per million of inhabitants **No data**



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II. Context and structure of the National Innovation System

Business Environment

1. Business structure and business financing system

1.1. Industrial structure

- ▶ Share of large firms and mature SMEs in the total number of enterprises

Small and Medium Enterprises (SMEs) are spread across all sectors, accounting for 49% of all enterprises. (Source: https://www.newvision.co.ug/new_vision/news/1435853/medium-enterprises-smes-supplement)

- ▶ Share of technology-based high-growth companies in the total number of enterprises:
No data found
- ▶ Size of the informal sector in the economy
95.2%

1.2. Firms' capacity for innovation creation and absorption

- ▶ Innovation capacity of national firms
High - As reported by Mayanja (2012) Uganda was found out to be among the top three countries with advanced technological and innovation capabilities in Africa.

1.3. Level of development of banking and venture capital

- ▶ Availability of financing through the local equity market
Low

Despite the existence of both public and private capital markets in Uganda, SMEs are yet to actively participate in these markets. Is it because there are better financing options than the capital markets in Uganda, such as retained earnings and banking finance as clearly depicted in the statistics, or the capital markets are a viable option but they are still underdeveloped and the SMEs are not attractive to would be investors? Certainly bank financing and Internal financing are not sustainable, especially if SMEs are aiming at growing and expanding their markets (Gibson 2008). Bank financing unlike equity financing exerts a substantial financial cost on SMEs in terms of interest payments which can greatly affect the cash flows of the business (Gibson 2008). The continuous drain of the business cash flows by interest payments can have a substantial negative impact on the working capital position of the company thereby hindering its ability to grow and expand. In some cases excessive debt obligations have been the cause of the SME business failures (Gibson 2008). It is also suffice to say that corporate bonds, a major component of capital markets financing like bank loans, also exert a substantial cost on SMEs in terms of interest payment obligations. Bank financing does also require collateral in addition to the interest payment obligations. On average 86% and 97% of loans taken out by Small and Medium sized companies respectively require collateral (World Bank 2006). Collateral requirements are exorbitant and are indeed one of the major bottlenecks of access to business finance among SMEs because usually SMEs do not have any substantial tangible or intangible assets. On average the value of collateral needed for a loan is 173% of the loan amount (World Bank 2006). In small companies the average value of 121% of the loan amount and in medium sized companies it is 173 % (World Bank 2006).



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► Availability of venture capital
High

There are a number of sources for venture capital in the country, however, there are many challenges that make it hard for institutions to access them. The most popular impediments are the high interest rates, coupled with poor management and bureaucracy. Since these barriers make accessibility almost impossible, the high availability of venture capital opportunities is somewhat neutralized.

Source: <https://chimpreports.com/experts-most-ugandan-businesses-unqualified-for-funding/>

► Affordability of loans for enterprises
Very low

Affordability is very low and this is premised on the following obstacles:

High Interest Rates

In Uganda Commercial banks average lending rates remain high, averaging between 18% - 26%, due to lack of competition in the banking sector. This was reasoned by the following factors: few banks controlling a large market share, high operational inefficiency, high operational costs and the high risk of borrowers.

Collateral Requirements

When granting loans, commercial banks protect themselves with assets (mostly real estates) collateral that is two to three times the value of the loan. The conventional requirements usually exclude the SMEs because they often lack assets. Many banks, particularly the transnational ones, do not accept collateral that is far from the main urban centers (King, K. and McGrath, S. (2002). Globalization, Enterprise and Knowledge. Symposium, Oxford).

High & Multiple Transaction Cost

Commercial banks require the following in securing loans: application fees, processing fees, monitoring fees, insurance and compulsory savings which have contributed to the high and are part of the multiple transaction costs. (Dondo A. (2003).

Risky Sectors

Most Banks perceive the SME sector as being risky. The perception is that small clients do not have stable, viable businesses for which to borrow and from which to generate repayment. The agricultural sector is also not favoured by the commercial banks due to its nature of unpredictability which is as a result of its high dependency on external factors like weather.

Delays in Processing

Many banks do not quickly process loans for SMEs within the time or season in which they require them.

Inflexible Conditions attached with the loans

In general, most loans that can be accessed by SMEs do not come without strings attached, e.g. Limited term i.e. limited number of years within which to pay the loan, limited grace period within which to start paying the loan.

Product Awareness

Some SMEs come up with innovative products that could easily be produced for local or international markets. Banks in general are not at ease with SMEs producing products that they are not sure will be sustainable in the market.



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Savings Mobilization

The Credit Crunch has also contributed to the fact that banks are even less willing to lend to SMEs. Many of them are now focusing on Savings customers or salary-based loans for individuals which have a very low default rate.

Variety of Financial Products for SMEs

There is limited variety of financial products at the banks for SMEs.

- ▶ Ease of access to loans
Not very easy for the majority of the population (as elaborated above).
- ▶ Share of SMEs that have secured a loan
No data found
- ▶ Share of low-interest loans for SMEs within the total number of loans for SMEs
No data found
- ▶ Stability of the banking system

Some level of instability is observed as exemplified by closure of some commercial banks, such as Crane bank, Cooperative bank, and Greenland bank.

- ▶ Availability of financial services

Financial services are available through banks, microfinance institutions, money lenders, government support.

- ▶ Affordability of financial services
Low

Firm behaviour

2.1. Managerial Talent

- ▶ Share of higher education students studying in areas of business, administration and law
No data found
- ▶ Quality of management schools

Makerere University Business School (MUBS) which is a benchmark for management training in Uganda is ranked number one in Africa, according to Eduniversal Masters Ranking (2015- 16). MUBS's Master in International Business was rated the third (3rd) in Africa. Its MBA programme was ranked tenth (10th) on the continent. MUBS is also ranked the most popular business school in Africa and the 32nd popular business School in the world. MUBS has produced forty (40) PhDs since its establishment. There are other business schools in the country, both public and private. This include, among others, Datamine Technical Institute, African College of Commerce, Global Institute of Information and Business, and Business Schools and Faculties at Universities.

Source: <https://ugfacts.net/list-business-schools-uganda/>



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2.2. Time horizon and risk tolerance of firms

- ▶ Share of capital investment in companies' expenditures:
No data found
- ▶ Share of R&D investment in companies' expenditures:
No data found
- ▶ Risk tolerance of firms:
No data found

2.3. Adoption of ICT in firms

- ▶ Corporate investment spending in hardware, software, and telecommunications as share of overall capital investment:
No data found

Cultural factors

3.1. Demand for innovation

- ▶ Final consumption expenditure of households:
No data found
- ▶ Secondary education enrolment rate and tertiary education enrolment rate (as proxies to receptiveness to innovative products and services)

Secondary education enrolment rate: **44%**

This implies that only 44 percent of students who were expected to be in secondary school (13-18 years) were actually enrolled in secondary school. (https://www.ubos.org/wp-content/uploads/publications/03_2018Education_Monograph_Report_Final_08-12-2017.pdf).

Tertiary education enrolment ratio:

In 2011, gross enrolment ratio in tertiary education for Uganda was **4.5%**.

Source: <https://knoema.com/atlas/Uganda/topics/Education/Tertiary-Education/Gross-enrolment-ratio-in-tertiary-education>

- ▶ Population receptiveness to innovative products and services:
Low

Whereas many innovations have penetrated the economy of Uganda many people take long to adopt them with a fear of their impact in the economy, i.e. their cost, and also lack of skills to apply them. The adoption is normally a very slow process thereby affecting their receptivity. The government also tends levy high taxes on some of the innovations that are perceived to be a political threat.

- ▶ Innovation-intensive pockets within industries already exist:
In very few industries

3.2. Social attitudes to risk taking and entrepreneurship

- ▶ Success and failure rates of new start-ups:



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50%. Source: <https://inachee.com/wp-content/uploads/2013/07/preventing-business-failure.pdf>

- ▶ Societal acceptance of business failure and entrepreneurship-related risk:
Low

There is high fear for business failure which makes most entrepreneurs remain small scale and informal. This becomes a norm of society not to accept failure of business, thereby fearing to take risks of growing big.

3.3. Social attitudes towards Science and Technology

- ▶ Secondary education enrolment rate and tertiary education enrolment rate (as proxies for attitude of the population to science and technology)

As mentioned above, the secondary education enrolment rate is 58%, and the tertiary education enrolment rate is 4.5%.

- ▶ Quality of math and science education at all levels - as a proxy for attitude of the population to science and technology
No data found
- ▶ Societal acceptance of technology and its impact:
High

The advent of technology leaves no choice for any society but to adopt. Furthermore, the majority of Ugandan adults are youthful, with a very high drive for technology exploration. The use of technology has greatly impacted on most spheres of life, including communication and education and so there is high societal acceptance of technology and its impacts.

III. Trade, Tax, and Regulatory Environment

Long-term structural economic factors influencing the innovation system

1.1. Specialization of industry

- ▶ Contribution of high-tech, medium-tech and low-tech sectors to the trade balance

The value of Uganda's exports has been less than imports for many decades since the highest proportion (about 80%) of the total exports comprises of Agricultural products whose values are very low relative to products imported from foreign markets. The export of high-tech products in Uganda accounts for a very small contribution to Uganda's trade balance. For example, in 2016 high tech exports contributed only about US\$ 7,556,939 to the total export value of US\$ 2.27 Billion which was even less than half of the total value of imports (US\$ 5.53 billion) for that year. The share of both medium and high-tech exports for Uganda in that year was only 0.171 of the total value of exports, as per the World Bank Data. The persistent deterioration of Uganda's trade balance is due to high importation of high value manufactured products which are meant for infrastructural development and technological innovations.

- ▶ Manufacturing trade as percentage of GDP



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In terms of contribution to GDP, manufacturing subsector (both formal and informal) contributes very little to the country's GDP. For example, according to Shepherd (2016), in 2014 its contribution to GDP at current prices stood at 9.6 percent. According to Obwona, Shinyekwa, Kiiza, and Hisali, (2014), the contemporary problems facing the industrial manufacturing sector in Uganda cover five dimensions:

- (a) the tiny share of industry in the sectorial distribution of GDP;
- (b) the predominantly last-stage assembly nature of industry in Uganda (suggesting low value added manufacturing);
- (c) the problem of excess capacity, with capacity utilization averaging about 50 percent of installed capacity; and
- (d) the absence of manufactured products in the export basket, pointing to Uganda's limited capacity to compete in the competitive global markets.

Manufacturing sector in Uganda is small and largely engaged in production of low valued products. The sector is dominated by SMEs, which account for 90% of establishments in the country's manufacturing sector. According to Ggoobi, Wabukala and Ntayi (2017), the manufacturing sector in Uganda constitutes a small share of industrial GDP and of overall GDP. It has been low and static, averaging about 7% over the last decade, and is below the average of 11% for least developed countries (LDCs). As pointed by Muwanguzi, Olowo, Guloba, and Muvawala (2018) Uganda's industrial sector comprises mainly of manufacturing, mining and quarrying, construction, and utilities (electricity and water supply) sub-sectors, whose industries are categorized into formal and informal. As a sector, industries contributes 19.8% to GDP, of this, manufacturing sub sector, which comprises of food processing, manufacture of beverages and tobacco, textiles clothing and footwear, paper and printing, chemicals, petroleum and other chemical products, non-metallic minerals, basic metals and metal products among others contributes 9.2% of industrial sector's GDP.

► High-technology exports as percentage of manufacturing exports

High-technology exports (percent of manufactured exports) in Uganda was reported at 1.833% in 2016, according to the United Nations, Comtrade database through the WITS platform (2016). Manufacturing in Uganda consists predominantly of last-stage (end-product) assembly and raw materials processing, a high share of which is food processing. Both of these are low value added activities. There are very few capital goods industries. Agro-processing firms account for about 39% of manufacturing establishments in Uganda, according to Uganda Bureau of Statistics (2012).

► Capital goods imports as share of overall imports

According to the research carried out by the Audit firm KPMG in 2017, Uganda's major imports include: Fuel which accounts for 16.5% of total value of imports, Machinery (8.4%), Pharmaceuticals (6.5%), and Vehicles (8.7%). There is substantial evidence of the high share of capital goods import in the total value of Uganda's import. According to the World Integrated Trade Solution report (2015), in 2015 importation of capital goods was US\$ 1,215,842, which accounted for approximately 22% of total import value (US\$ 5,528,117). Generally, the demand for capital import is high in Uganda and weighs on the trade balance leading to persistent trade deficit.

► Capital goods exports as share of overall exports

According to the data compiled by the World Integrated Trade Solution (2015), the share of capital goods export is alarmingly low. For example, in 2015 the total value of exports was US\$ 2,267,008, out of which the export of capital goods accounted for only about 6.3% (US\$ 145,070). Shepherd (2016) tried to show the breakdown of the contribution of some components of capital goods to the overall share of



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exports as follows: Equipment contributes 0.83%, Iron and Steel - 4.46%, Manufacture of metals - 1% and Power generating machinery and equipment - 0.49%.

1.2. Foreign Direct Investment (FDI)

▶ FDI outflow as percentage of GDP

Foreign direct investment net outflows (% of GDP) in Uganda were reported at 2.3086% in 2013, according to the World Bank collection of development indicators, compiled from officially recognized sources. Economic theory suggests that FDI outflow discourages growth by reducing total factor productivity and, more generally, the efficiency of resource use in the recipient economy. This works through three channels: the linkages between FDI and foreign trade flows, the spillovers and other externalities vis-à-vis the host country business sector, and the direct impact on structural factors in the host economy.

▶ FDI inflow as percentage of GDP

Uganda Investment Authority (2015) statistical abstracts indicates that Foreign Direct Investment inflows amounted to US\$ 894.2 million in 2011. In the year 2012 FDI inflows increased by US\$ 311.2 million to US\$ 1,205.4 million. The increased inflow was mainly on account of direct equity capital and borrowings. In 2014 the total value of FDI in Uganda was US\$ 1,147 million, which was about 3.9% of Uganda GDP (US\$ 29.3 Billion). However, the percentage of the FDI inflow contribution to GDP was the second highest in East African countries in 2014, following Tanzania (4.44%). In fact, the values of the FDI inflows have been consistently high in Uganda due to favourable investment climate and due to the newly confirmed vast mineral resources and nascent oil sector, which registered commercial findings of oil. The Investment Code Act (1991), which allows foreign participation in any industrial sector except those touching on national security or requiring the ownership of land, provides a very good investment climate for foreign Investors.

1.3. Knowledge intensity of the economy

▶ Share of knowledge-intensive industries and services in the value added in the business sector (GDP-by-industry)

Knowledge-intensive industries and services consist of firms that provide inputs based heavily on advanced technological or professional knowledge to the business processes of other organisations. This industry consists of a range of activities such as computer services, research and development (R&D) services, legal, accountancy and management services, architecture, engineering and technical services, advertising and market research, among others. According to the explanatory notes for Uganda GDP in 2014, the performance of this sector in Financial Year 2014 declined by 3.9%. The contribution of professional scientific and technical services activities to the total GDP at current prices was 2.3% in CY 2014 compared to 2.6% in CY 2013.

▶ Knowledge-intensive services exports as share of overall exports

Knowledge intensive services are advanced services that use more R&D, more technology and more highly skilled workers. Knowledge intensive services are critical to growing Uganda economy to the middle-income country as envisaged in the government's vision 2040. The high value jobs of today



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(doctors, nurses, engineers, science professionals, teachers, IT professionals), and of the future are the drivers of the knowledge intensive services sector. In the absence of substantial data indicating the contribution of knowledge-intensive services to exports of Uganda, the increased importation of experts in Uganda (for example, the recent government's plan of importing Cuban doctors) suggests that the Knowledge intensive service sector in Uganda is still narrow. It further suggests that its contribution to Uganda's exports is low.

1.4. Hotspots in key technologies

- ▶ There are key technology sectors or regions specializing in technological industries that emerge as hotbeds of innovation

Yes, there are sectors in the technological industries that have emerged as hotbeds of innovations in Uganda. The innovative breakthroughs of these sectors justify why Uganda was classified as an innovation achiever in 2014 by Global Innovation Index (GII). The Government of Uganda through the ministry of Education, Science, Technology and Sports (MOEST) promotes the institutional, structural, and human capacity elements of the innovation ecosystem for the STEM fields (Science, Technology, Engineering and Mathematics). Through the above initiatives, many Uganda Universities have come up with innovative ideas and products with the most notable one being the Kiira EV electric car that was built by students of Makerere University. As the technological sectors emerging as hotbeds of innovation include Agro-processing sector, many innovative ideas here are geared towards value addition to agricultural products under government's policy of wealth creation. It should however, be noted that Uganda is not among innovation achievers according to the key findings of the global innovation Index (2018)

1.5. Ongoing structural change / reforms in the economy

- ▶ There are ongoing reforms to upgrade the manufacturing sectors through research and technologies

Yes, the reforms to upgrade the Manufacturing sector in Uganda are embedded in the National Industries Policies of 2008. Promotion of Innovation, especially at the stage of product development, concerns about value addition at various stages of supply chain of manufacturing firms, and manufacturing product diversification are parts of some ongoing reforms in manufacturing sector that involves a lot of research and technologies. The outcomes of these reforms are reflected in the adoption of new technology, introduction of new and improved goods and new designs and fashions by manufacturing firms.

- ▶ There are ongoing reforms to upgrade the non-manufacturing sectors through research and technologies

The non-manufacturing sector of Uganda's economy, where heavy upgrades through research and technologies are being performed, mainly comprises of the service sector, especially in fields of information and communication technology with vibrant opportunities in broadband services. The education, hospitality and health support services are among the growing non-manufacturing sectors that government is upgrading technologically. For example, the reform of higher education system to enhance pedagogy, accessibility, modes of delivery, access to research data bases are some of the



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technological innovations to upgrade the education sector in the country. Government of Uganda plans to set up electronic libraries with on-line linkages to reputed scientific information repositories, accessible to all major Universities and towns in the country to ensure economical and equitable access to world class information and publications. This is done in partnership with private sectors and consortia like Consortium for Uganda Universities Library (CUUL). In health sector, upgrades are ongoing in response to the need for proper management of complicated cases like cancer, which needs advanced technologies.

1.6. Communication and ICT infrastructure

▶ Internet subscribers per 100 inhabitants

According to Pewresearch (2015), Internet usage in Uganda is quite low compared to other developing countries in South East Asia and Sub Saharan Africa, despite the fact that Internet usage has a very high link with the country's economic development. Comparatively, the study shows that 28% of people in the sample in the age of 18-34 years in Tanzania use the Internet and own smartphone compared to 16% for Uganda. 11% of respondents in Tanzania in the age of 35+ use the Internet and own smartphone compared to 3% for Uganda. 27% of high-income earners in Tanzania use the Internet and own smart phone compared to 17% for Uganda. According to UBOS (2015), the number of Internet subscribers per 100 inhabitants are estimated at 13 in 2015.

▶ Share of households with Internet access at home

According to UBOS (2017) statistical abstract, in 2016 the total number of fixed internet subscribers increased by 13.7% compared to those registered in 2015. In the same period there was a 76.6% increase in mobile wireless internet subscriptions up from the 29.1% increase in 2015. Internet penetration also increased by 51.9% in 2016 compared to 39.7% increase in 2015. United Nation (2017) estimates the percentage of internet penetration in Uganda at 31.3%.

▶ Computers per 100 inhabitants

According to the Uganda National Household Survey (2017), the proportion of people who had used computers in the last three months from June 2017 backwards was 4 people out of 100. Out of the people using computers, 56 people out of 100 used Desktop computers, 36 out of 100 used Laptops and 8 out of 100 used Tablets and other handheld computers.

▶ Fixed-broadband internet penetration (subscribers per 100 inhabitants)

Mobile broadband is an important market not only to the country's telecom sector, but also to the wider Ugandan economy and society. The service is capable of reaching the majority of the country's population and represents the primary means of internet access. According to Uganda Communication Commission (2014), as of June 2014, there were 4.1M mobile broadband subscriptions in Uganda, representing a penetration of 11.7% over the population. The market has grown compared to 3.6M in 2013 and 2.6M in 2012. These numbers represent a Compound Annual Growth Rate (CAGR 2010-2014) of approximately 70%. Device prices are still a significant barrier to mobile Internet adoption; many consumers use feature phones with limited data functionality. There is a small fraction of approximately 3.5 million total fixed broadband connections in Uganda. According to Ministry of



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Information, Communication Technology and National Guidance (2018), Uganda currently, ranks 153rd in the world for fixed internet penetration with only 3 per 1000 inhabitants having access to fixed internet. Yet, for most, if not all business outfits, industries, research/ academic institutions, IT/Innovation hubs (BPO), ICT and industrial parks require dedicated fixed internet.

► Internet access tariffs (20 hours per month), as percentage of per capita income

The authors did not get reliable exact data for the above measure. However, existing literature which investigated the relationship between internet access and GDP growth for developing countries have noted positive correlation between the two variables. As indicated Guerriero (2015) and McKinsey (2013), in Africa, the Internet's contribution to overall GDP is approximately 1.1%. An empirical study by World Bank (2009) with specific reference to developing countries, reports that a 10% increase in broadband and a 10% increase in wire line Internet penetration are associated to a 1.38% and a 1.12% increase in GDP growth, respectively. Moreover, specifically a study by Ericsson (2013) in Brazil, India, and China found that, introducing a 0.5 Mbps broadband connection increases household income by USD 800 per year. Despite its significance to the growth of GDP, internet access attracts costs on the side of an internet user in the name of tariffs. The cost of internet access in Uganda remains higher than in most countries in the region, partly because of Uganda's landlocked nature that means it does not have direct access to marine fibre. Nonetheless, the cost of internet bandwidth has been progressively falling. For instance, the average cost of 1 Mbps/month from National Information Technology Authority-Uganda (NITA-U) to government agencies (MDAs) stood at US\$ 70 as of January 2018, down from US\$ 600 in 2013. Moreover, this progressive cut in the bandwidth price by NITA-U has prompted Internet Service Providers to correspondingly lower their prices, as can be seen in figure 2.2 below. The commercial ISPs have accordingly slashed their prices for 1 Mbps/month from an average of US\$ 617 in 2013, down to US\$ 300 in 2015 and further down to US\$ 237 in 2018 representing a 61.9% reduction in the price of 1 mbps over the last 6 years. Based on these data, we can estimate the cost of internet access tariffs of 1Mbps/month (US\$ 237) as a percentage of Per capita Income (US\$717.5) to be 33%.

► Percentage of localities with public Internet access centres by number of inhabitants (rural/urban)

Data for the percentage of localities with public internet access centres (PIAC) is limited. For instance, National Information Technology Authority (2013) conducted a research to assess electronic governance readiness (e governance) in Uganda, and no single respondent provided any response to the above measure which was included in the questionnaire. In other words, no inhabitant responded to having access to public internet.

Regulatory Environment

2.1. Ease of starting a business and ease of doing business

► Ease of starting business

Uganda ranks number 116 on the ease of starting Business and scores 71.3%, according to the Ease of Doing Business Report (2017). This ranking is the lowest compared to the scores of some selected countries in East Africa such as Kenya (83.13%), Burundi (94.45%), Rwanda (87.17%) and Tanzania (79.14%). The best performance globally includes New Zealand scoring 99.96%.



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► Ease of doing business

A World Bank Group flagship report (2017) ranks Uganda relative to comparator economies on the Ease of doing business. The ranking considers four sets of indicators namely: starting a business, registering property, enforcing contracts and labour market regulation. Uganda scores 57.77% in the ranking, which is slightly above the regional average of 49.51% for Sub Saharan Africa. In East Africa, Rwanda gets the highest score of 69.81%, this finding suggests the medium score for Uganda on the Ease of Doing Business relative to other economies.

2.2. Ease of closing business, resolving insolvency and laying off workers

► Entrepreneurs do not have to struggle with excessive bureaucratic requirements when downsizing or closing business

It seems there could be some excessive and bureaucratic requirements when downsizing or closing business in Uganda. This is evidenced by the low rank assigned to Uganda on the ease of resolving insolvency in Uganda. Globally, Uganda stands at 111 in the ranking of 190 economies on the ease of resolving insolvency, according to the Ease of Doing Business flagship Report (World Bank, 2017). Uganda scores 39.4%, which is slightly higher than the average score of 30.16% for Sub Saharan Africa. However, Uganda ranks relatively lower scores compared to other countries such as Kenya (43.39%), Rwanda (47.85%) and Tanzania (41.04%).

► Investors can obtain reasonable capital recovery rates when a business goes bankrupt

The average recovery rate is 38.4 cents on the dollar, according to the Ease of Doing Business Database (2017). This rate is higher than the average recovery rate of 22.5% for Sub-Saharan Africa. This suggests that investors can receive reasonable capital recovery rate after insolvency.

► The insolvency regime allows for companies facing temporary distress to restructure in order to avoid liquidation

The insolvency Act (2011), section 44 (1) and (2) of Uganda spells out the annulment, revocation or setting aside of bankruptcy order under the circumstances clearly spelt out in the same section. In essence, this implies that the Insolvency Act allows for companies facing temporary distress to restructure in order to avoid liquidation.

2.4. Transparency, anti-corruption and the rule of law

► There are objective criteria on the basis of which firms can receive government services, such as permits, subsidies, grants and quality certificates

The criteria on the basis of which firms can receive government services appear to be quite objective. For example, according to the international ranking provided in the Ease of Doing Business report (2017), Uganda ranks number 116 with the percentage score of 55.81% on the ease of registering a property. For comparison, Tanzania scores 51.57% in this indicator. Similarly, Uganda scores 60.6% on the ease of enforcing contracts, while Kenya scores 58.27%, Rwanda - 56.76%, and the Sub Saharan



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average for this indicator is 47.73%. Dealing with construction permits, Uganda ranks number 151, with the score of 57.75%, equal to the Regional Sub Saharan average. For comparison, Kenya scores 57.75% and Rwanda 55.4% in this indicator. This suggests that the criteria, on the basis of which firms can receive government services, are relatively objective.

► Overall level of transparency

The index which measures the perceived levels of public sector corruption worldwide classifies the level of corruption in Uganda as high. On a scale where a score of zero implies a very high level of corruption, according to Corruption Perception Index (2017), Uganda scores 26, which is higher than the Sub-Saharan average score of 32 and the global average score of 43. Other highly corrupt African countries in the ranking include South Sudan (12), Somalia (9) Congo (21).

2.5. Tax policies

► Tax support for business R&D (allowances, credits or other forms) is available in the country

The government of Uganda is providing a wide range of tax incentives to businesses to attract greater levels of Research and Innovations in areas of Agribusiness, Energy and Natural resources and Training. The Ministry of Finance, Planning and Economic Development is responsible for granting tax incentives and exemptions. KPMG (2017) provides a schedule for tax incentives in key business sectors in Uganda. For example, licensees for mining operations and petroleum operations are allowed 100% deduction of exploration and development expenditure. The supply of power generated by solar and the supply of goods and services to the contractors and sub-contractors of hydro-electric power projects is an exempt supply under the VAT Act. In the field of Agriculture, the supply of machinery, tools and implements for the use only in agriculture is an exempt supply under the VAT Act. Other tax exemptions and allowances are shown in the VAT Act.

► Rate of corporate tax in the country

The corporate tax rate of Uganda is relatively high. Branches of foreign companies are taxed at a corporate rate of 30% and additional tax of 15% on repatriated branch incomes. However, businesses with gross turnover of up to UGX 150 Million can apply small business rate. According to Deloitte (2017), corporate tax rates, tax rates for selected countries range from 0% for Anguilla, which indeed is referred to as “tax heaven” for businesses, to 30% for countries in high tax rate bracket. The corporate tax rate of 30% in Uganda is higher than the world average rate of 22.5% across 188 countries. Europe has the lowest tax rate of 18.88% on average, however, this average rises to 26.22% when it is weighted by GDP of European countries.

2.6. Intellectual property protection regime

► There are laws on patents

It is true that Ugandan law protects intellectual property rights, however, there are still challenges of piracy and counterfeit distribution. While the Uganda Registration Services Bureau provides a standardized process for registering each type of intellectual property and allows for investors to enforce their rights through the court system, enforcement remains weak. Over the past two years, the Uganda Police Force (UPF) established the “Intellectual Property Police” unit to enforce IPR and businesses are



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reporting an increase number of IPR prosecutions. Uganda signed the World Intellectual Property Organization's Patent Law Treaty in 2000, but has not yet ratified it. On January 6, 2014, Uganda's president assented to the new Industrial Property Act, which replaced previous legislation like the Patent Act, 1993, and goes a long way towards protecting intellectual property and bringing Ugandan law into consonance with international standards on intellectual property. Patents are granted for inventions which are a solution to a specific problem in the field of technology. It may relate to a product or a process (Section 7 of the Patents Act CAP 216 herein referred to as the Act). For an invention to qualify for patentability, it must meet the following three conditions: it should be *novel* (Section 9 of the Act), *involve an inventive step* (non-obvious) (Section 10 of the Act), and be *industrially applicable* (useful) (Section 11 of the Act).

▶ There are laws on utility models

A Utility Model just like a Patent also protects inventions/ innovations but for a shorter period. The main difference between a Patent and Utility Model is that the requirements for granting a Utility Model are less stringent than for Patents. A product or process which is novel and industrially applicable passes for Utility Model, inventive step is not a requirement. The term of protection for utility models is 10 years as per section 69(3) of the Industrial Property Act of Uganda. The industrial property Act 2014, Section 68 (1) provides for the promotion of inventive and innovative activities, to facilitate the acquisition of technology through the grant regulation of utility models. The industrial Property Act, section 68(3) applies to new inventions and designs that can be awarded the certificate. It states that "An invention qualifies for a utility model certificate if it is new and industrially applicable". It seeks to protect the newly invented models and designs. A certificate of utility model is prima facie evidence that the holder is the registered owner of a utility model with the registrar.

▶ There are laws on industrial design

Yes, the laws on industrial design seek to protect the innovators from reproduction and replication of the same designs by the third parties. These laws also prohibit designs that are contrary to public order (Section 72 of the Industrial Property Act 2014). Section 92 of the same Act also prohibits infringement of the industrial design.

▶ There are laws on trademarks

A trademark is a distinctive sign or mark used in trade to distinguish your goods or services. Trademarks identify the source of products to the consumers. A trademark can be any distinctive word, symbol, slogan, logo, brand label, name, signature, letter, numeral or any combination of them. There is the law on trade mark, which prohibits the infringement of trade mark (Section 1 of the Trademarks Act 17/2010). However, a person may not institute an action for an unregistered trademark to prevent or recover damages (Section 34 of the Trademarks Act).

▶ There are laws on copyright and related rights

Yes, there are laws on the copy right and other related rights, the copy right and neighbouring Act 2006 provides for the protection of literary, scientific and artistic intellectual works and their neighbouring rights; and also, other related matters. S.5 of the act protects the author of any work from copyright infringement.



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► There are laws on trade secrets

A trade secret is any confidential information used in business that gives a competitive advantage. Examples include formulae, recipes, pattern, technique, compilation, method, program, process, device or product mechanism. No registration is required. This basically means that disclosing the secret would make the information far less valuable.

As indicated in the Uganda Gazette, No 27, Vol C11 dated 12th June, 2009, there exists An Act called the Uganda Trade Secret Act (2009) which provides for the protection of undisclosed information in commercial transactions and to provide for other related matters. The Uganda Trade Secret Act (p.3), applies to governmental agencies, and persons regardless of the nature of the entity or the purpose for which it exists. Nothing in this Act is intended to impose on any person a liability for the acquisition, disclosure or use of information, where that information is acquired in the course of that person's work, and the information is of a character that the acquisition would amount to not more than an enhancement of that person's personal knowledge, skill or expertise. This Act does not affect any rules of equity or the common law by virtue of which obligations of confidence arise with respect to the disclosure, acquisition or use of confidential information.

► There are laws on plant varieties

Yes, there are laws on plant varieties in Uganda. As indicated by Advocates Coalition for Development and Environment (2008, No. 6, pp. 1- 2), Uganda, like many other countries, is a party to the World Trade Organization (WTO) Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs). Article 27.3 thereof requires member countries to provide protection for new plant varieties either by patents or by a sui generis system or by a combination of both. In a bid to fulfil its obligations under the TRIPs Agreement, the country has for the last ten years been developing a plant breeders' rights legislation for the protection of new plant varieties. The need for plant variety protection arises from the need to reward especially the formal plant breeders for their investment in terms of Research and Development (R&D). Plant breeder's protection ordinarily leads to improvement and enhancement of existing plant varieties. Through scientific means, plant breeders are able to develop varieties with a number of desirable traits including high yielding, drought resistant, nutritive & medicinal and pests & disease resistant traits. Plant breeders' rights are the major form through which plant variety protection is achieved. Plant Breeders' rights can generally be defined as exclusive rights granted to a person over the commercial production and marketing of reproductive or vegetative propagating material of the protected plant variety. The monopoly/ exclusive rights are granted for a limited timeframe during which the rights holder is expected to have recouped his/her investment. The practice has been to grant a time frame ranging between 15-25 years. Uganda has been developing its plant variety protection legislation along the lines of the African Model Law. In this context, the 2004 Bill (which is the latest) seeks to recognize and protect the rights of private and public breeders over the varieties developed by them; to recognize, protect and support the inalienable rights of local communities including farming communities over their plant varieties, and to provide for matters incidental thereto.

► The national IP office has an independent legal status and enjoys autonomy from the government



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Yes, the National IP offices have an independent legal status under the Uganda Registration Services Bureau (URSB) created by the URSB Act Cap. 210 Laws of Uganda. The Bureau is semi-autonomous and is mandated to evaluate from time to time the practicability and efficacy of its services with respect to the relevant laws it administers. The Bureau is responsible for registration of companies and business names, partnerships, documents, debentures and chattels transfer, intellectual property rights including registration of patents, utility models, industrial designs, trademarks, service marks, copyright and neighbouring rights, births, deaths, adoption orders, and marriages, liquidation of companies and bankruptcy.

- ▶ The national IP office has regional coverage (i.e. is not operating only in the capital)

There are no offices upcountry.

- ▶ The national IP office is appropriately staffed in terms of number of staff and qualifications of staff

The IP directorate at the Uganda Registration Services Bureau appears not to be very well staffed, according to statistics given by the Uganda Registration Services Bureau (URSB 2016). On the top of the staffing structure is the Registrar General who is assisted by two Deputies: Deputy Registrar in charge of General duty and Registries, and Deputy Registrar in charge of General duties and Finance and Administration. Under the Deputy in charge of registries is the Director in charge of Intellectual Property, and under Finance and Administration Deputy is the Director of ICT and Director of Finance. The number of staff under the IP directorate is 18 and the one with the lowest rank are the two Assistant Records officers. This staffing level seems to be low given the target workload of 280 trade mark files, 7 copyrights 60 local applications processed per week.

- ▶ The national IP office can perform both formal and substantive examination of patent applications

Like in many African countries, Uganda National IP offices seems not to have a technical competence of performing both formal and substantive examination of patents. The genesis of this dysfunctional IP examinations in Africa has been best explained by Adams and Adams (2012). According to that paper, African IP offices were lacking technical expertise, local patent applications were very few or non-existent, and therefore it was felt that the complex work of examining and granting patents could be done in Europe, thus removing the burden and the need to establish examination offices or even develop a local capacity to administer patent applications in Africa. Consequently, adoption of Substantive Examination Systems and reliance on Regional System for actual examination is the order of the day. In other words, there is over reliance on African Regional Intellectual Property Offices for substantive examination of patents. African Regional Intellectual Property Offices (ARIPO) examines national Patent applications from Botswana, Ghana, Lesotho, Uganda, Swaziland, and Namibia. Uganda became a signatory to the Banjul Protocol in 2013 and this mandates ARIPO to perform formal and substantive examination of patents for Uganda but following Uganda laws.

- ▶ The work of the national IP office is automated and modernized (i.e. there is no reliance on manual processing)



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The work is highly automated given that Uganda Registration Services Bureau has a full directorate of ICT. There is the Industrial Property Automated System (IPAS) which is an IP administration system that automates processing of trademarks, patents and industrial designs. Currently, URSB is using IPAS JAVA Version 2.7. IPAS is used to generate IP statistics with exception of Copyright. The generated statistics depend on the information requested. These are then stored in a shared drive so that other officials can refer to them as and when desired. Despite the automated system, manual registers are also maintained as requirement of the law for applications and registrations of Copyright, Trademarks and Patents. Manual registers are also used in providing information/ statistics. Statistics are compiled on weekly, quarterly and annual basis and shared with the Registrar General, Planning section and all IP staff.

- ▶ The mandate of the national IP office supports the enforcement of IP

Yes, it is true that Ugandan law protects intellectual property rights; however, there are still challenges of piracy and counterfeit distribution. While the Uganda Registration Services Bureau provides a standardized process for registering each type of intellectual property and allows for investors to enforce their rights through the court system, enforcement remains weak. Over the past two years, the Uganda Police Force (UPF) established the “Intellectual Property Police” unit to enforce IPR and businesses are reporting an increase number of IPR prosecutions.

- ▶ The mandate of the national IP office includes promotion of innovation

Intellectual Property mandates include promotion of innovation by providing the legal rights which result from various intellectual activities. This includes the right to: trademark, service marks, commercial names and designations. Invention in all fields of human endeavor (patents), industrial designs, scientific discoveries, literary, artistic and scientific works (copyright), Performances of performing artists, producers of phonograms and broadcasters (Neighboring rights). IP further promotes protection against unfair competition and trade secrets. For example, on September 25th 2016, news awashed media houses about an innovation by Mugarura, a final year student of Chemistry and Botany in Makerere University, when he unveiled tear gas, which he claimed was made from a tiny store in his mother's house using common items like onions and red pepper and mangoes. In a quest to promote such innovations, the Uganda Registration Services Bureau (URSB) granted him a utility model on 22/3/2017 because some elements of the application were novel (new) and had industrial applicability (URSB 2017 PP 13).

- ▶ There is a national body competent to deal with the prosecution and management of IP rights (e.g. an IP Tribunal)

Yes, there is the directorate of IP in the Uganda Registration Service Bureau which is a semi-autonomous body established by the Act of Parliament. The directorate is well staffed with 12 employees.

2.7. Public procurement rules

- ▶ According to the applicable legislation, public procurement can be used strategically as a means of promoting innovation as a secondary objective



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Yes, Public Procurement and Disposal of Assets Act was amended in 2012 to enforce reforms that can make procurement a strategic function with positive impact on the development of Uganda. In fact, Public Procurement contributes about 70% of Uganda's total budget. The PPDA Act (2012) emphasizes innovations like E-Procurement, which are meant to curb down inefficiencies in the procurement process and to foster transparency, accountability and professionalism in public procurement in Uganda. Section 85 of PPDA Act provides for a sole source procurement or disposal method for procurement or disposal requirements where under special circumstances, competitive method cannot work. This section can strategically be applied to protect suppliers of innovative products against competition.

IV. Innovation policy environment

R&D and Technology

1.1. Government support for R&D

- ▶ Government funding for R&D in Universities and public research organizations (PROs)
- ▶ Direct government funding for Business R&D

Key Centres of Research and Technology in Uganda

- National Agricultural Research Organisation (NARO) provides research funding for agricultural research conducted in Uganda and funds businesses for research and development.
- National Council of Science and Technology receives funds from government to facilitate research and innovations in Universities and public research organizations.
- Uganda Bureau of Statistics (UBoS) dedicates fund exclusively to research.
- Government funding for Universities is based on quota systems for districts to support students in acquiring higher education. Though the funding is still limited at this level of education. Furthermore, the Ministry of Education and Sports (MoES) awards state scholarships and grants admission to higher institutions of learning for students, who completed Advanced level of education with outstanding performance.
- Budgetary allocation to the education sector has continued to rise. There are three main sources of funding for Research in Public Universities; Internally Generated Funds, Government Subvention and Donor funding. According to a report by Kyaligonza et al. (2015) at least 80 percent of the research funds at Mbarara University comes donors who invest in research with a particular motive.
- Ministry of Science, Technology and Innovations was created in 2016 to provide a basis for enhancing sector coherence and coordination. A Presidential Initiative on Science and Technology was started to enhance the development of science and research. With a support of 25 billion Uganda Shillings spread over a period of five years the initiative intended to support existing research projects, commencing in 2011. The presidential innovations fund for the Faculty of Technology at Makerere University was then adopted by the government of Uganda to build the country's scientific innovations (Statehouse Uganda website: www.statehouse.go.ug; [http.mak.ac.ug](http://mak.ac.ug)).

The government, through its ministries supports research and innovations by sending out calls for grant applications and fellowships. Grant applications mainly support research and development projects that have gone beyond proof of concept nearing industrial production and commercialization. It also supports the emphasis of linking research to industry, so that the output is increased on prototypes as well as



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new knowledge (<https://www2.fundsforngos.org/latest-funds-for-ngos/government-of-uganda-call-for-proposals-the-national-science-technology-and-innovation-programme-nstip/>).

1.2. Technology transfer policy

- ▶ There are legislative acts, policies or public agencies enabling or supporting the commercialization of research or technology transfer from universities or PROs to industry and the marketplace

Yes, the relevant acts and policies include:

- The National Agricultural Research Act, 2005;
- Uganda Small and Medium Enterprises policy, 2015;
- National Science, Technology and Innovation policy, 2009;
- Uganda Bureau of Statistics (UBoS) Act, 1998;
- National Development Plan, 2015/2019;
- and Vision 2040.

Knowledge Flows

2.1. University-industry collaboration

- ▶ Number of world-class research-intensive universities in the country: **9**
- ▶ Are public universities encouraged and supported by the national or regional/ local governments to cooperate with industry: **Yes**

The curricula of the universities provides for internship programmes for all undergraduate programmes at public universities and most private universities. The interns within the industrial setting get practical experience while on internship. They interface with the real life experience in the industry and at the end of the programme they prepare an internship report.

- ▶ Capacity building activities for knowledge transfer are organized: **Yes**

To some extent, some institutions provide for knowledge transfer, under very specific projects. For example the Food Incubation Centre and Makerere University provides for knowledge transfer. Others include CURAD for Agribusiness, at Makerere University Agricultural Research Institute, Kabanyolo.

- ▶ Level of development of university-industry cooperation **Medium**

Examples include collaboration between the Ministry of Agriculture, Animal Industry and Fisheries (M.A.A.I.F.) to improve the agricultural sector (Makerere University College of Agricultural and environmental Sciences (2017); Report on the proceedings of the stakeholders consultative meeting 26th April 2006, partnership in national development; Twelfth principle's quarterly Report, Kampala Uganda).

2.2. Technology Diffusion and Adoption Systems

- ▶ Are there programs for firms encouraging them to adopt certain technologies? **Yes**

The government initiated an e-governance system, which is an integrated system to support all government agencies in different aspects of operation. For example it is a requirement for all



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government institutions to use IFMIS for financial management, a software for integrated financial management.

Human Capital

3.1. Research capacity in the innovation system

- ▶ Total R&D personnel as a percentage of total employment - **No data found**
- ▶ Quality of research training – **Low (generally)**

No financial resources are allocated by Uganda National Council of Higher Education (NCHE) to support research in HEIs. Besides, some higher education institutions in Uganda deliver unaccredited courses; there are disparities in delivering similar programmes in both sciences and humanities, amongst institutions. Equally, there are declining numbers of foreign students and low PhD production in the higher institutions of learning (State of Higher Education report 2013/14. Available at www.unche.or.ug. Accessed on 23/5/2018).

- ▶ Quality of scientific research institutions

As compared to other African countries, the quality of scientific research institutions in Uganda is still underdeveloped. These institutions have lower numbers of personnel in science-based disciplines and poor infrastructure development (UNCST, 2012). Research institutions are also characterised by lack of financial resources to support research and by low numbers of staff with a PhD degree to enhance research activities (State of Higher Education report 2013/14. Available at www.unche.or.ug, Accessed on 23/5/2018).

- ▶ Science, Technology, Mathematics and Engineering enrolment ratio in higher education (i.e. share of higher education students enrolling in STEM subjects)

Enrolment is still low with high gender disparities (MoES, 2017). Apart from Makerere University, most Universities in Uganda have very few PhD lecturers engaged in teaching science subjects, as well as disparities in enrolment for Science and Humanities programs. UNCST, 2012; UNCHE, 2012; MoES (2017) Education and Sports Sector Strategic Plan 2017/18 - 2019/20, Kampala; State of Higher Education report 2013/14. Available at www.unche.or.ug, Accessed on 23//2018).

- ▶ Availability of scientists and engineers (i.e. no shortage of scientists and engineers on the labor market)

Uganda National Council for Science and Technology (2017) indicates that, apart from computer sciences, there is low student enrolment but with high gender disparities, when it comes to scientists in other fields in Uganda.

- ▶ PhD degree completions per year per capita

There is no national statistics on PhD degree completion rates. However, UNCHE report (2013) states that in Uganda PhD completion rates are very low, which stands at 11%. The report by Walama (2011) elaborates on PhD completion rates at Makerere University. It is asserted that the overall completion rate of PhDs at Makerere University stands at 30.1%, which is very low compared to counterparts outside Africa.



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(UNCHE (2013). The State of Higher Education in Uganda: A report on Higher Education delivery and Institutions, Kampala Uganda; Wamala, R., Oonyu, J., & Ocaya, B. (2011). Completion time dynamics of doctoral studies at Makerere University: A hazard model evaluation. Journal of International Education Research, 7(3), 49.)

- ▶ Recruitment and promotion rules, as well as funding, of new researchers facilitate retention of researchers **Yes**
- ▶ Recruitment and promotion rules, as well as funding, of new researchers is transparent and based on research excellence **Yes**
- ▶ Salaries of researchers are competitive **No**

The laid out guidelines in the public sector, for recruitment enhance acquiring the most competent researchers, based on experience, academic level and prior academic excellence. The concept of job security through permanent employment is a key factor to retention, even when they salaries are not competitive compared to other public institutions in the region. However, for the private sector, whereas there are recruitment laws, they are not always followed due to the absence of high quality researchers, who get swallowed by better paying public institutions. Retention in this case is relatively low.

3.2. Education and training

- ▶ Performance of students on internationally comparable standardized tests like PISA and TIMMS
Data not available
- ▶ Enrolment rate in secondary education

Secondary school

The sector experienced an increase of 13.5 % in total enrolment from 1,284,008 (675,163 boys; 608,845 girls) in FY 2015/6 to 1,457,277 (765,406 boys; 691,871 girls) in FY 2016/17 (MoES (2017). Education and Sports Sector Strategic Plan 2017/18 - 2019/20, Kampala Uganda)

- ▶ Funding per pupil/ student
Data not found
- ▶ Share of students coming from socio-economically disadvantaged families
Data not found
- ▶ School drop-outs (early school leavers) as a share of the student population

52% of pupils who enrol for primary education complete their education (53% of boys and 42% of girls) (Policy Brief No. 8 – Sept. 2009 (DFID); Consortium for Research on Education, Access, Transitions and

Equity

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwjmurzXib_hAhXMxiUKHWiTCdkQFjAAegQIBhAB&url=https%3A%2F%2Fwww.unicef.org%2Fuganda%2FOUT_OF_SCHOOL_CHILDREN_STUDY_REPORT_FINAL_REPORT_2014.pdf&usg=AOvVaw0viHqidWtGcn_q0Byzq6y).

- ▶ Share of schools with internet access



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By 2005, Uganda had only 2,070 secondary schools connected to the Internet (Country profiles Uganda, 2006). Uconnect and SchoolNet Uganda, two major NGOs involved in ICTs for schools, led these projects. Connectivity is much more prevalent in urban than rural schools, basically because access to ICT infrastructure for schools mirrors the national rural-urban divide (Country Profiles Uganda., 2006. DFID. Available at www.dfid.gov.uk/countries/africa/uganda.asp).

Reports from the Ministry of Education and sports do not indicate clearly issues related to internet access in secondary schools (MoES, 2009; MoES, 2013; MoES, 2017). Rather the reports suggest that secondary schools have access to ICT facilities. Ministry of Education and Sports together with Cyber School Technology Solutions provided E-Learning solutions (Digital Science and Virtual Labs) to 350 secondary schools in Uganda so as to enhance the use of ICT as a pedagogical tool during science (Biology, Chemistry, Physics) and mathematics lessons (MoES, 2013).

In addition, the same report indicates that the ministry of Education and Sports entered into an agreement with Uganda Communications Commission (UCC) to provide hardware equipment and software to government aided secondary schools. The Ministry further established ICT laboratories in 829 Government aided schools (MoES (2009). Statistical Abstract, Kampala Uganda; MoES (2014). The Education and Sports Sector Annual Performance Report 2013/14, Kampala Uganda).

- ▶ National curriculum standards exist
Yes
- ▶ There is a shortage of teachers
Yes
- ▶ School system encourages independent learning and creative thinking
Yes

There is indication from various sources that the government and public are dissatisfied with the current curriculum, arguing that it needs to be overhauled because it is highly theoretical and does not spur scientific innovations (UNCST, 2012). Ongoing efforts strive to review the curriculum to educate independent learners who are more innovative and to raise up young people who are job creators, rather than to train people for white collar jobs (MoES, Uganda Education statistical Abstract 2009; 2016; National Curriculum Development Centre (NCDC) (2012). Institutional Repositioning to a centre stage in National Development: A strong institution Innovative Strategies Empowering Education. Approved five Year strategic plan 2012/2016, Kampala Uganda.)

- ▶ Quality of STEM education

The quality of stem education is still low as explained in the preceding paragraphs.

3.3. Skills training

- ▶ Private sector investment in skills training as a share of GDP

Private sector companies provide internships and industrial training to students at higher institutions of learning.

- ▶ Support is offered to disadvantaged persons to access skills training
Yes



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There are specialized centers imparting skills to some disabled students. For example Old Kampala School of the Deaf trains students in carpentry, metal fabrication, etc.

- ▶ Youth apprenticeship programs exist

Yes

For example the Youth Apprenticeship Program developed by the Uganda Investment Authority (UIA) and Vantage Communications Ltd. This programme was specifically developed for the unemployed youth in Uganda.

- ▶ Tax credits for company investments in workforce development are available

No

- ▶ There are higher education institutions that provide short-cycle degrees focused on skills training

No

- ▶ Specialized training services are available at local level

Yes

There are many private and government training centers, especially in business, catering, carpentry, metal fabrication, artistic works, computer engineering etc. Such centers include Michelangelo College of creative Arts.

3.4. Brain drain or influx of high-skilled labor

- ▶ There is a brain drain from the country

Yes

- ▶ Percentage of foreign students enrolled in PhD programmes

National Council for Higher Education report (2013) highlights that there are few foreign students studying in Uganda, but does not provide concrete statistics on this. (State of Higher Education report 2013/14. Available at www.unche.or.ug, Accessed on 23/5/2018).

- ▶ Immigration policy encourages the influx of high-skilled labour

Yes

- ▶ The country is able to attract and retain talent

The country is not able to retain talent. For example, out of 5000 qualified doctors only 1200 work in public sector; the rest are abroad seeking for well paid jobs (Daily monitor, fifth Dec, 2017; Capuano, S. & Marfouk, A. (2013) African Brain Drain and its impacts on source countries. What do we know and what do we need to know? Journal of Comparative policy Analysis research and Practice, 15(4):297-314).

3.5. Lifelong learning

- ▶ Share of the population aged 25 to 64 participating in education and training



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Data not found

- ▶ Incentives for lifelong learning are offered
Yes

ICT uptake in relation to lifelong learning is still minimal due to underdeveloped ICT infrastructure (Kawoya, D. (2004). Universal Access to ICT and Lifelong learning Uganda's Experience new library world 105(11/12),423, 423-428.)

Poor quality of nursing care is reported in developing countries, and attempts to improve it through continuing education programs exist but not well explored in Uganda (Muliira,J.K, Etyang, C., Muulira, R.S, & Kiiza, I. B. (2012). Masses Orientation Towards lifelong learning: A case study of Uganda's National Hospital. The Journal of Continuing Education in Nursing, 43(2): 90-96).

Okello-Obura, C. & Kigongo- Bukenya, I.M.N (2011). Library and Information Science Education and Training in Uganda: Trends challenges and the way forward. Education Research International, 2011.)

- ▶ Diverse opportunities for lifelong learning are available
Yes

There are ongoing efforts towards raising awareness on the need for lifelong learning, but there are still existing challenges given low literacy levels.

Structure and specificity of the higher education system

4.1. Participation in Higher Education

- ▶ Enrolment rate in tertiary education

Between 2006 and 2011 the total increase has been from 137,190 to 198,066, representing a growth of 44.4% (UNCHE, 2013).

- ▶ Share of the population with tertiary education

Ugandan citizens within the age group of 19-24 years who have attained tertiary education are estimated at 19.2% (UBoS (2017). The national population and Housing census 2014. Accessed from http://www.ubos.org/onlinefiles/uploads/ubos/2014censusprofiles/education%20monograph%20report_final%2008_12_2017.pdf).

4.2. Diversity, concentration and specialization in the Higher Education sector

- ▶ Private HEIs exist
Yes
- ▶ Enrolment is divided between many universities (as opposed to concentrated in one major university while the others serve much smaller percentages of enrolled students)
Yes
- ▶ Share of universities performing excellent research
Public universities (9)



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- ▶ There are universities focused primarily on teaching rather than research, while other universities typically characterized as research-intensive
Yes
- ▶ Research funding is concentrated into those HEIs that perform research (as opposed to being thinly spread among many or all universities)
Yes

4.3. Funding of HEI

- ▶ Public investment in Higher Education (as percentage of GDP)

No statistics is found (NCHE, 2013). However, Government of Uganda, Auditor General (2010) indicates that there was generally limited finding for higher education in Uganda and that the unit costs for each student per course offered was higher than funds provided. Yet the higher institutions were not allowed by government to increase the fees to meet the high costs. (GoU, Auditor general department (2010). Unit cost Study of Education at Public universities in Uganda, Kampala Uganda.)

- ▶ Funding for Higher Education is performance-based
No
- ▶ Performance contracts/ agreements are used to monitor university performance
No
- ▶ Performance contracts/agreements are linked to funding
Yes - for non-government funding and **No** - for government funding
- ▶ Industry funding for universities is allowed by law
Yes
- ▶ Enrolment fees are payable by students
Yes
- ▶ International funding represents a substantial part of university funding
Yes

4.4. Integration of knowledge transfer with core university missions

- ▶ Knowledge transfer is part of the mission and core strategy of public universities
Yes
- ▶ There is public funding dedicated to knowledge exchange and knowledge transfer
Yes
- ▶ Applied sciences degrees are offered
Yes



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4.5. University governance

- ▶ Prevalent governance model in the university system

Representational governance: governance is vested in a wide array of stakeholders, such as students, academic staff, alumni, corporate partners, government, and civil society.

- ▶ Universities have autonomy from the state in academic matters
Yes
- ▶ Universities have autonomy from the state in financial matters
No - for public universities; **Yes** - for private universities
- ▶ Universities have organizational autonomy from the state
No
- ▶ Universities have autonomy with regard to staffing decisions
No - for public universities; **Yes** - for private universities
- ▶ University missions are clearly stated and differentiated in terms of the goals that the institutions seek to achieve
Yes
- ▶ Universities in the country have strong management and strategic planning
Yes
- ▶ Universities in the country are accountable to a variety of stakeholders other than the government (civil society, students, etc.) with regard to their
 - a) academic output: **Yes**
 - b) social impact: **Yes**
 - c) financial management: **Yes**
- ▶ Stakeholders other than the government have a say in university governance
Yes

4.6. Strength of entrepreneurship education

- ▶ Share of universities that offer courses on entrepreneurship or creativity
No data found

Structure of the National Innovation System

5.1. Quality of public research organizations (PROs)

- ▶ PROs have substantial publishing activity
Yes



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For example, the National Agricultural Research Organization (NARO) has a journal called “Uganda Journal of Agricultural Sciences” through which they publish their research. Others include the African Crop Science journal housed at the College of Agricultural and Environmental Sciences, Makerere University.

- ▶ PROs regularly engage with industry
Yes

Most of the medical programmes, both academic and research are conducted within the hospital setting. The personnel are normally shared. This enables research findings to easily be tested for viability and reliability. The College of Engineering, Design, Art and Technology (CEDAT) at Makerere University, conduct research in partnership with the industry (Kiira Motors) to see how to improve the efficiency of transportation through manufacturing of energy efficient cars.

- ▶ Financing of PROs is adequate
No
- ▶ There is professionalized management at PROs
Yes
- ▶ There is entrepreneurial culture within PROs
Yes

Ministry of Science, Technology and Innovation was launched in 2016, showing that there are upcoming developments towards promotion of innovations. There exist legal frameworks to support innovations, though implementation is still a challenge. They include: The Copyright and Neighbouring Rights Act, 2006; Uganda National Bureau of Standards Act, 1983, 1983.

5.2. Links between universities, PROs and industry

- ▶ Clusters exist in which research organization and universities take part
Yes

Some academic department have Research extensions. For example The College of Agricultural and Environmental Sciences (CAES) at Makerere University has Makerere University Agricultural Research Institute, Kabanyolo (MUARIK), and Makerere University Biological Field Station (MUBFS). If possible, please, provide a few examples of such clusters. Additionally, the institutions host joint conferences and research dissemination gatherings. Annually CAES hosts a joint conference with NARO (Mak-NARO Conference).

5.3. Research funding

- ▶ There is an independent and professional research funding agency in the country
No
- ▶ The process of evaluation and funding of scientific and scholarly proposals is transparent and peer-review based
Yes

5.4. Existence of innovation bridging institutions and boundary spanning organisations



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- ▶ Incubators: **Yes** (eg. Outbox, Hive Colab, The Hub Kampala, The Mara Launch Pad and government owned Uganda Industrial Research Institute (UIRI))
- ▶ Accelerators: **Yes** (eg. Unreasonable East Africa, GrowthAfrica, Accelerate, Imuka Ventures)
- ▶ Technology and science parks: **Yes** (eg. Namanve Science park)
- ▶ Technology transfer offices: **Yes** (Eg. Uganda Industrial Research Institute - UIRI, Uganda Registration Services Bureau - URSB)
- ▶ Networks of companies: **Yes** (Eg. Uganda Manufacturers Association – UMA, Uganda Investment Authority – UIA)
- ▶ Regional development agencies: **Yes** (Eg. Uganda Development Corporation – UDC which is under the Ministry of Trade, Industries and Cooperatives)
- ▶ R&D units within universities: **Yes** (Eg. Directorate of Research and Graduate Training – GRDT at Makerere University).

5.5. Research ethics

- ▶ Research ethics and responsibility are discussed within the public sphere and within research circles
Yes

Ethics committees exist in the Universities and the National Council of Science and Technology registers all researches conducted in Universities where ethical issues are prioritised (UNCST (2014). National Guidelines for Research involving Humans as research participants, Kampala Uganda).

5.6. Involvement of stakeholders in the innovation system – users, grant making agencies, civil society organizations

- ▶ Channels, initiatives or innovation platforms/ networks exist for stakeholders and stakeholder organizations to become involved in innovation activities at the grassroots
No

5.7 International linkages and collaboration

- ▶ Share of PhD students from the country relocating for a period of study to a different country
No data found
- ▶ Share of foreign PhD students among all PhD students
No data found
- ▶ Share of universities involved in international research or capacity building projects
No data found

Policies and measures in support of innovation

6.1. Coordination of education, research and innovation policies

- ▶ An up-to-date government strategy/ overall policy on research and innovation exists:
Yes



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The National science, Technology and Innovation Policy (2009). The policy highlights the importance of STI in the development of the country. The Objectives of the policy are to:

- i. Create an enabling policy environment to foster STI and augment their contribution to national development.
- ii. Build STI sector capacity to generate and transfer technology.
- iii. Establish and strengthen the legal and regulatory framework to ensure ethics and safety in STI development and application.
- iv. Strengthen the STI coordination framework to enhance sector performance.

- ▶ There are policies, strategies and reform plans of international/ supranational institutions that affect research and innovation in the country

No

- ▶ An up-to-date government strategy/ overall policy on higher education exists

Yes

The Universities and Other Tertiary Institutions Act, 2001 (Amended 2006). The main objectives are to:

- a) Establish and develop a system governing institutions of higher education;
- b) Regulate and guide the establishment and management of those institutions; and
- c) Equating the same professional or other qualifications as well as the award of degrees, diplomas, certificates and other awards by the different institutions.

6.2. Reform and modernization of education and research

- ▶ There are ongoing or planned modernization reforms in the HE and research sector:

Yes

Provision of online education platforms such as MUELE. Equipping of research labs at the institutions. Development of new programmes and establishments of Centres of Excellence at public institutions.

Conclusion

Generally, Uganda continues to spend very little on research. The country's competitiveness in science and technology is thus very low and is further declining. This trend is contrary to the efforts of African Union where a target of 1% has been set for all African Countries to achieve by 2020. Development partners and Government play a central role in supporting R&D. Foreign funding of R&D particularly plays a much more role in Uganda. Also, regarding STEM teaching, the Government and development partners will have to prioritize learning and skilling not just schooling. This may necessitate the overhauling of the curriculum to enable training of learners who are independent thinkers and more innovative. This is more needed given that the country has little ability to attract and retain talent. Uganda experiences several business financing roadblocks that continue to hinder growth and contribution of SMEs to innovation. While several and diverse financial services exist in the Country, a combination of high interest rates, unaffordable collateral and numerous transaction costs limit access by SMEs. This is likely to continue curtailing the capability of SMEs as innovators. This constraint is compounded by other general hardships experienced in starting a business.

There are numerous opportunities for increased innovation in the Country. The marked continued growth of computer and internet usage, albeit from a low base, will likely continue to benefit the growth of businesses, industries, academic and ICT Centers. With high quality management of schools, Uganda also has better prospects for having human resources skilled in business, administration and law which are critical skills in leading changes in the innovation system.



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The business environment for innovation is positive given the comparatively fair ease of doing business in the country particularly a supportive and fairly objective access to Government services by firms. And while corporate tax rates are high, the country offers tax incentives to key businesses. Uganda's vibrant legal regime for intellectual property rights provides an opportunity for the national innovation system although the enforcement will likely remain an obstacle to protection of the provided rights for some time.

Therefore, to reinforce and ensure development in Research and innovations there is need to provide practical solutions to the existing problems. Supporting prototyping of innovations through provision of digital tools like 3D printers and Scanners can be a very ideal intervention. Also enhancing the capacity building programmes such as skills training can provide fertile ground for accelerating economic development through STIs.

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A graphic composed of several overlapping triangles in various colors (red, green, blue, yellow, orange, purple) forming a larger triangular shape.

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