Assessment of Knowledge Society Development in Botswana

June 2017

African Leadership in ICT (ALICT)

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This publication was prepared for GESCI to determmine the Knowledge socity in Botswana.

The views and opinions expressed in this report are those of the authors and do not necessarily reflect the official views of GESCI.

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Introduction

The Global E-Schools and Communities Initiative (Gesci), in collaboration with the African Union Commission (AUC) and other partners, developed an African Leaders in ICT (ALICT) capacity-building programme. The first phase of the programme ran from 2012-2013, focusing on leadership capacity-building in twelve countries (Botswana, Ethiopia, Kenya, Malawi, Mauritius, Mozambique, Namibia, Rwanda, South Africa, Tanzania, Uganda, and Zambia). A second phase of the programme ran between 2014 and 2016 and included four countries (Ghana, Ivory Coast, Morocco, and Senegal). ALICT has built the capacities of 487 mid and senior government leaders in 16 Anglophone and Francophone African countries, as well as officials from the AUC between 2012 to 2015. The Francophone version of the ALICT Programme is referred to as *the Leadership Africain pour les TIC et le développement de la société du savoir (LATIC)*.

The course presented a multi-stakeholder approach for awareness-raising and capacity-building of African leaders around issues of Knowledge Society (KS), Information, Communication Technologies (ICT), Education, and Science Technology and Innovation (STI) in support of the AUC Action Plan and the EU-AU P8. Courses comprised of contextualized, modular content, founded upon country research and reflecting the identified needs of country governments.

The programme is currently under review to integrate leadership for sustainable development components in line with international frameworks and AU continental strategies for achieving 2030 sustainable development goals and objectives. The focus is on a continent-wide expansion of the programme through a wider access model.

Aims and Objectives of the study

To inform future development of the ALICT programme, it is important to understand where the participating countries are at in terms of developing a KS. Thus, Gesci commissioned Neil Butcher and Associates to prepare updates on the status of the KS in the 16 participating countries. Specifically, the focus was to update the situational and needs analysis of each country to keep abreast of developments since 2013 regarding the KS and its pillars of Education, STI, and ICT.

The specific objectives of the study were to:
* Update briefs of country KS pillars for the ALICT-LATIC Database.
* Update the ALICT KS country study database of the KS pillar status in each country, which involved:
  – Desk review of country KS documentation, identifying essential policies, strategies, plans, and papers on KS;
  – Review of KS pillar documentation sets related to Education, ICT, and STI; and
  – Identification of major actors, stakeholders, and partners and their role in KS pillar development.

Methodology

The report methodology involved a desk review of various government policy and strategy documents. Additionally, documents from development partners, research and academic papers, news articles, websites, and publications from various organizations were consulted. Further, data from the 2013 report were included where relevant. A framework for the country reports was

prepared, outlining what the various sections would cover. This was done to ensure uniformity in the type of information collected. The major areas and themes covered included policies and plans in ICT, Education, and STI. Additionally, socio-economic background information and indicators were reviewed to obtain an understanding of the context of each country. After receiving approval from Gesci for this framework, draft reports were prepared for each of the 16 countries. The reports were sent to Gesci for review and, based on feedback received, the reports were then finalized.

Overview of theoretical model[1]

Modern economies are transforming from agricultural and industrial economies to information and knowledge-based economies. Such rapid transformation has had significant impact on social, economic, political, and cultural development across the world. For such development and growth, ICT is seen as both a driver and an enabler towards establishing and developing the various sectors in an economy that contribute to stronger, more developed, and richer societies. Africa is on a journey of transformation towards information and knowledge societies. During any such transformational journey, the leaders of a society and policy makers are likely to undergo a paradigm shift that involves developing their capacity and providing tools and direction for accepting relevant changes in mindset.

Dahlman (2011) defines a KS as a society that values the creation, dissemination, and effective use of knowledge, and has the institutions, infrastructure, norms, social interactions, and culture that support this.[2] UNESCO (2005) describes a KS as one that is nurtured by its diversity and its capacities. It further argues that, in the increasingly knowledge-based world, it is critical to embrace knowledge and innovation-related policies to spur competitiveness, growth, and improvements in welfare.[3]

Gesci believes that ICT, education, and innovation are the critical pillars and key elements for development towards a knowledge-based future. Butcher (2010) visually captured the inter-relationship between the three pillars as follows:

Figure 1   Framework for reflecting on ICT, Education, Innovation and Development Support of a Knowledge Society[4]
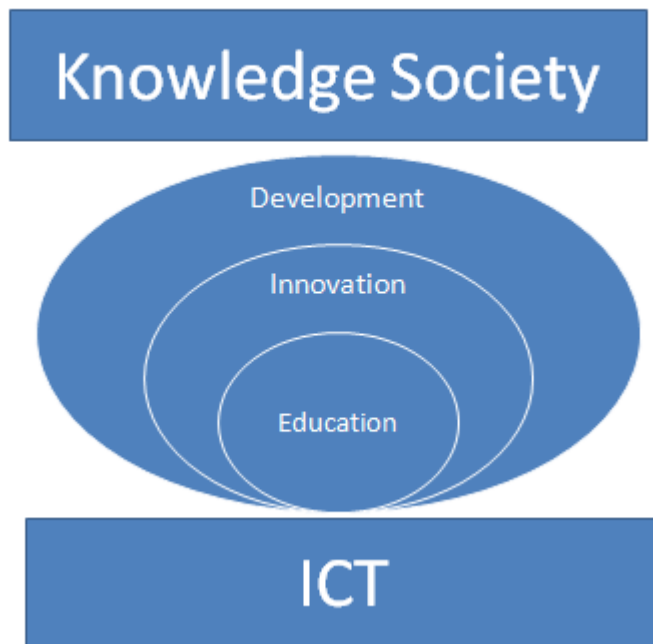
The innovation pillar incorporates the fields of Science, Technology, and Innovation (STI) in a single pillar. The education and innovation pillars are presented as interrelated drivers for development. The ICT pillar is the enabler for Education and Innovation dynamics that will drive Development towards the Knowledge Society. [5]

ICT is regarded as an engine for growth and a tool for empowerment, which has profound implications for education change and socio-economic development. UNESCO (2007) defines ICT as

> *Forms of technology that are used to transmit, process, store, create, display, share or exchange information by electronic means. This broad definition of ICT includes technologies such as radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, and computer and network hardware and software, as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs.[6]*

ICT is considered a critical tool in preparing students with the skills required for the global workplace. Thus, technology integration is becoming a key element in almost every plan for the restructuring and re-engineering of education systems.[7] This enables continuous adaptation to a

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[4] Neil Butcher and Associates. (2011). Thematic Paper: ICT, Education, Development, and the Knowledge Society. Gesci. Retrieved July17, 2017 from
http://gesci.org/fileadmin/user_upload/4_ICT_in_STEM_Education_Files/ICT__Education__Development__and_the_Knowledge_Society_1__1_.pdf

[5] Hooker, M. (2011). African Leadership in ICT and Knowledge Societies: Issues, Tensions and Opportunities for Learning for Gesci. Retrieved July 17, 2017 from
http://gesci.org/fileadmin/user_upload/1_African_Leadership_in_ICT_and_Knowledge_Society_Development_Files/2013_-_african-leadership-knowledge-societies-issues-tensions-opportunities-learning.pdf

[6] UNESCO Bangkok. (2007). The UNESCO ICT in Education Programme. p.1. Retrieved July 17, 2017 from
http://unesdoc.unesco.org/images/0015/001567/156769e.pdf

[7] Scheffler, F.L., and Logan, J.P. (1999). Computer Technology in Schools: What Teachers Should Know and Be Able to Do. *Journal of Research on Computing in Education,* Vol 31, Issue 3. Available from
http://www.tandfonline.com/doi/abs/10.1080/08886504.1999.10782257

work world of continuous technological innovations and makes it easier for students to access knowledge.

Challenges of ICT within Africa often relate to lack of human and financial resources, which translate into inadequate and insufficient skills supply, irrelevant or incomplete regulatory frameworks, including policies and legislation, and inadequate infrastructure and communication platforms.[8] To embrace a KS, Gesci believes that there is a requirement to ensure that leaders develop skills to make informed policy and investment decisions to support socio-economic development effectively. This encompasses building both leadership ICT skills and ICT management skills.

Lifelong learning is regarded as a requirement to keep pace with the constantly changing global job markets and technologies. Education contributes to all other sectors by providing required skills and knowledge for economic development. Thus, it is not limited to formal education in traditional structures, but encompasses the broader societal learning necessary for development. Preparation for lifelong learning involves an emphasis, in primary and secondary schools, on learning general skills and competencies (communication, mathematics and science skills, new literacy skills, problem-solving and interpersonal skills, and self-directed learning skills to learn other subjects) and at tertiary level on capacity-building in science and technology, discipline-specific skills, research, and development.[9] Additionally, there is a need for postgraduate programmes to build specific research capacity to handle knowledge-innovation process development – to meet needs and demands for national and regional competitiveness and growth. Education plays critical roles in imparting learning skills.[10]

Innovation is described as a process of creation, exchange, evolution, and application of knowledge to produce new goods. It involves adapting, adopting, or using knowledge to produce new goods and services in local contexts or to advance society in general.[11] The UN Economic Commission for Africa (UNECA) (2010) regards innovation and change as fundamental when developing a KS to drive economic growth and advancement. It has been argued that the basic ingredient for nurturing the innovation dynamic is setting up systems to enable cross-fertilization of ideas between the fields of Science, Engineering, Technology, and Innovation (SETI).[12]

Overview of the ALICT-LATIC programme

The ALICT Programme is conceptualized to model a methodology and multi-stakeholder approach for capacity building and awareness raising of African leaders on the issues of the KS, ICT, Education, and STI.[13] The programme is based on the premise that investments in ICT, Education, and STI contribute to socio-economic development and a shift towards the development of a KS.

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[8] Hooker, M. (2011). African Leadership in ICT and Knowledge Societies: Issues, Tensions and Opportunities for Learning for Gesci.

[9] Neil Butcher and Associates. (2011). Thematic Paper: ICT, Education, Development, and the Knowledge Society. Gesci. Retrieved July17, 2017 from http://gesci.org/fileadmin/user_upload/4_ICT_in_STEM_Education_Files/ICT__Education__Development__and_the_Knowledge_Society_1__1_.pdf

[10] Hooker, M. (2011). African Leadership in ICT and Knowledge Societies: Issues, Tensions and Opportunities for Learning for Gesci.

[11] Hooker, M. (2010). Concept note: Building Leadership Capacity for ICT and Knowledge Societies in Africa. Gesci. Retrieved July 17, 2017 from http://gesci.org/fileadmin/user_upload/1_African_Leadership_in_ICT_and_Knowledge_Society_Development_Files/2012_-_ConceptNoteALICITFinal.pdf

[12] Hooker, M. (2011). African Leadership in ICT and Knowledge Societies: Issues, Tensions and Opportunities for Learning for Gesci.

[13] Hooker, M. (2011). African Leadership in ICT and Knowledge Societies: Issues, Tensions and Opportunities for Learning for Gesci. Retrieved July 17, 2017 from

The programme's focus is to build absorptive capacity of current and potential future African leaders to acquire, assimilate, transform, and exploit the benefits of knowledge. It aims to foster dynamic organizational capability through knowledge sharing, collaboration, and exposure to technology. It is hoped that, through participation in the ALICT-LATIC course, future African leaders will demonstrate knowledge, skills, and attitudes that promote their role as change agents. These are expected to translate into positive benefits for their respective countries in pursuit of inclusive knowledge societies.

The core concepts of the programme are as follows:
- Capacity Building: The ALICT capacity-building model aims to build and enhance the knowledge, skills, and attitudes of future leaders to manage transformation and change, manage institutional pluralism, enhance coordination, foster communication, and ensure that data and information are shared and used in planning, resource mobilization, implementation, and evaluation processes.
- Knowledge Society: The ALICT model focuses on the role all facets of ICT play in building the absorptive capacities of current and potential future African leaders to acquire, assimilate, transform, and exploit the benefits of ICT and knowledge to produce a dynamic organizational capability through peer knowledge sharing and exposure to technology. The ALICT approach to KS development focuses on the interconnection between leadership, policy development, and future-proof planning and how they contribute to KS development through Education, STI, and ICT.
- Leadership: A prerequisite for leadership development for knowledge societies is policy coherence between the three pillars (ICT, Education, and STI) that form the basis of any KS. For future African leaders to be able to steer their countries towards that goal, it is essential for them to not only be well versed in management, leadership, project formulation and project management skills, but also to acquire comprehensive knowledge about the interrelationship of the three KS pillars (Education, STI and ICT) and then be able to apply that knowledge in the African context.
- Policy Coherence: Policy coherence is the development and implementation of conjointly supportive policy actions across all sectors of the economy and society and, more specifically across government departments and agencies. Policy coherence pursues the creation of synergies across policies that advance the achievement of shared and agreed objectives. Within national governments, policy coherence issues arise between different types of public policies, between different levels of government, between different stakeholders, and at an international level.
- Futures Thinking: Futures Thinking was first theorized by Jim Dator (Bezold, 2009). Among its many uses within complex and rapidly shifting economic and social systems is its relevance to policy development and implementation. Futures Thinking requires the revisitation of plans and policies at regular intervals to take into consideration any new signals that appear in the environment that may affect a sector or number of sectors.[14]

Considering Sustainable Development Goals

The 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development officially came into force in January 2016. These new goals apply to all countries when mobilizing

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http://gesci.org/fileadmin/user_upload/1_African_Leadership_in_ICT_and_Knowledge_Society_Development_Files/2013_-_african-leadership-knowledge-societies-issues-tensions-opportunities-learning.pdf

[14] Taken verbatim from African Leadership in ICT Model Document 2013 - The Future of African Leadership is here. Retrieved July 17, 2017 from
http://gesci.org/fileadmin/user_upload/1_African_Leadership_in_ICT_and_Knowledge_Society_Development_Files/ALICT_Model__final_Juho.pdf

efforts to end all forms of poverty, fight inequalities, and tackle climate change over the next 15 years.

> *They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and addresses a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection.[15]*

While the SDGs are not legally binding, governments are expected to take ownership of, and establish national frameworks to achieve, the 17 Goals: no poverty; zero hunger; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice, and strong institutions; and partnerships for the goals.

Primary responsiblilty for follow-up and review of progress made in implementing the SDGs rests with countries. Implementation and success of the SDGs depends on countries' own sustainable development policies, plans, and programmes. However, regional follow-up and review will be based on national-level analyses and contribute to follow-up and review at the global level.[16]

Whilst implementation of SDGs is still in early phases, it provides an opportunity to frame the ALICT programme as a mechanism for countries to address SDGs, due to the programme's cross-cutting nature. Specifically, KS development relies on the progress made in many of the SDGs.

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[15] United Nations. (no date) Sustainable Development Goals – 17 Goals to Transform our World. Retrieved July 17, 2017 from http://www.un.org/sustainabledevelopment/development-agenda/
[16] United Nations. (no date) Sustainable Development Goals – 17 Goals to Transform our World. Retrieved July 17, 2017 from http://www.un.org/sustainabledevelopment/development-agenda/

Knowledge Society Development in Botswana

1 Introduction

Botswana is a landlocked country covering 581,730 km[2]. Botswana borders South Africa, Namibia, Zimbabwe and very marginally Zambia. Formerly a British protectorate known as Bechuanaland, Botswana gained independence in 1966. Since attaining democratic governance and a multiparty constitution, it has had significant capital investment and has a stable economy. Botswana has one of the most progressive and inclusive programmes to deal with the HIV/AIDS pandemic in the continent, however, it still holds one of the highest rates of infection.[17]

Figure 2   Map of Botswana[18]

Botswana has maintained one of the world's highest economic growth rates since independence in 1966, mainly due to the mining of diamonds. The revenue earned from diamonds drives Botswana's economy and currently accounts for one quarter of GDP, approximately 85% of export earnings, and about one-third of the government's revenues. Tourism is the secondary earner of foreign exchange and many Batswana engage in subsistence farming and cattle raising. Through fiscal discipline and sound management, Botswana transformed itself from one of the poorest countries in the world to a middle-income country with a per capita GDP of $17,700 in 2015. Two major investment services rank Botswana as the best credit risk in Africa.[19]

Botswana's Vision 2036 sets out its updated national development path, and follows on from Vision 2016. Vision 2036 has four pillars, namely: Sustainable Economic Development, Human and Social Development, Sustainable Environment and Good Governance, and Peace and Security. The goals of

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[17] Central Intelligence Agency – The World Factbook. (2016). Botswana. Retrieved March 16, 2017 from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/bc.html

[18] Central Intelligence Agency – The World Factbook. (2016). Botswana. Retrieved March 16, 2017 from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/bc.html

[19] Central Intelligence Agency – The World Factbook. (2016). Botswana. Retrieved March 16, 2017 from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/bc.html

Vision 2036 include transforming Botswana into a high-income country, where continued growth will be supported by a more inclusive, diversified and export-led economy, and building a sustainable environment through the optimal use of natural resources.[20]

The launch of Vision 2036 coincided with the 50th anniversary of Botswana's independence and the launch of the eleventh National Development Plan (NDP 11). NDP 11 covers a six-year period from April 2017 to March 2023 and comprises two volumes. Volume I deals with Policies and Strategies, while Volume II articulates on Projects and Programmes reserved for implementation during the Plan period. The theme for NDP 11 is "Inclusive Growth for Realisation of Employment Creation and Poverty Eradication". The theme is based on the fact that Botswana continues to contend with poverty, unemployment and income inequality as socio-economic development issues, though efforts were made during NDP 10 to achieve the goals of Vision 2016.[21] Vision 2036 and NDP 11 are aligned with the sustainable development goals (SDGs), and the government is invested in development that benefits all people.

The review of NDP 10 indicated that the economy is still highly dependent on minerals and customs and excise revenues, while the overall economy remains relatively undiversified. For this reason, NDP 11, puts more emphasis on diversification efforts to create employment opportunities, reduce income inequalities and poverty. The NDP 11 average GDP growth rate is estimated to be slightly higher than that of NDP 10.[22]

According to official government statistics, unemployment is 19.5%, but unofficial estimates claim unemployment is higher.[23]

Inflation in Botswana in 2016 was 3.8%.[24] The country's Gini Coefficient Index (which measures inequality in the level of income) was recorded at 60.46 in 2009.[25] Botswana received US$393 million of foreign direct investment during 2015, down from the 2011 figure of US$1.371billion.[26]

In 2015, Botswana ranked 2 out of 54 African countries on the Mo Ibrahim Index which offers a comprehensive assessment of governance that informs and empowers citizens, civil society, parliaments and governments as a tool of measuring progress in governance.[27]

The Global Competitiveness Index (GCI, 2016-17) which assesses the ability of countries to provide high levels of prosperity to their citizens through measuring the set of institutions, policies, and factors that set the sustainable current and medium-term levels of economic prosperity ranks

[20] Daily News. (2016). Vision 2036 to uplift Batswana. Retrieved April 19, 2017 from http://www.dailynews.gov.bw/news-details.php?nid=32777

[21] Tralac. (2016). Botswana's draft 11th National Development Plan: Presentation speech. Retrieved April 19, 2017 from https://www.tralac.org/news/article/10731-botswana-s-draft-national-development-plan-ndp-11-presentation-speech.html

[22] Tralac. (2016). Botswana's draft 11th National Development Plan: Presentation speech. Retrieved April 19, 2017 from https://www.tralac.org/news/article/10731-botswana-s-draft-national-development-plan-ndp-11-presentation-speech.html

[23] Central Intelligence Agency – The World Factbook. (2016). Botswana. Retrieved March 16, 2017 from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/bc.html

[24] The World Bank. (2016). Inflation, consumer prices (annual %). Retrieved April 10, 2017 from http://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=BW

[25] The World Bank. (2009). GINI index (World Bank estimate). Retrieved April 10, 2017 from http://data.worldbank.org/indicator/SI.POV.GINI?locations=BW

[26] The World Bank. (2015). Foreign direct investment, net inflows (BoP, current US$). Retrieved April 10, 2017 from http://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?locations=BW

[27] Mo Ibrahim Foundation. (2016). Ibrahim Index of African Governance. Retrieved April 10, 2017 from http://iiag.online/

Botswana 64 out of 138 countries with a score of 4.3.[28] The index points to poor work ethic, access to financing and an inadequately educated workforce as primary limiting factors.

The World Bank's "Ease of doing business" index, a measure of the relative ease for starting a running a local business, for 2017 ranks Botswana as 71 out of 190. Starting a business, enforcing contracts and getting electricity are still constraints.[29]

According to the Heritage Foundation report, Botswana's economic freedom score is 70.1 making it the 34th freest economy out of the 178 ranked countries and rated as "mostly free". Its score is 1 point down from the previous year. Botswana is ranked 2nd out of 46 countries in the Sub-Saharan Africa region, and its overall score is above the world average of 60.7. According to the Heritage Foundation, the regulatory environment encourages growth, and openness to foreign investment and trade promotes competitiveness. The financial sector is well developed, with little government intervention. To reduce dependence on diamond production, the government has introduced competitive corporate tax rates, streamlined the application process for business ventures, and is committed to increased transparency.[30]

According to the International Telecommunication Union (ITI), Botswana's (IDI) score for 2016 was 4.17, placing it 108 out of 175 countries and 5th in the region.[31] The World Economic Forum's Networked Readiness Index for 2016 ranked Botswana 101 out of 139 countries, with a score of 3.5.[32]

The population of Botswana in 2016 was estimated at 2,209,208.[33] In 2015, 64% of Botswana's population was between the ages of 15 and 64,[34] with 21% between the ages of 15 and 24.[35] The country has a fertility rate of 2.3 children per woman.[36]

In 2013, Botswana's CO_2 emissions stood at 2.492 metric tons per capita, up from 1.957 metric tons in 2009,[37] with total greenhouse emissions in 2012 at 82,110.[38]

The Botswana government is concerned with climate change as it has been attributed to longer drought episodes, changes in rainfall patterns, and outbreaks of crop diseases that affect the most important sector to rural households and subsistence agriculture. Botswana is experiencing

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[28] World Economic Forum. (2016). Global Competitiveness Index - Botswana. Retrieved April 10, 2017 from http://reports.weforum.org/global-competitiveness-index/country-profiles/#economy=BWA

[29] The World Bank. (2016). Doing Business. Retrieved March 10, 2017 from http://www.doingbusiness.org/rankings

[30] The Heritage Foundation. (2017). Botswana. Retrieved April 10, 2017 from http://www.heritage.org/index/pdf/2017/countries/botswana.pdf

[31] International Telecommunications Union. (2016). ICT Development Index. Retrieved March 10, 2017 from http://www.itu.int/net4/ITU-D/idi/2016/

[32] World Economic Forum. (2016). Global Networked Readiness Index - Botswana. Retrieved April 10, 2017 from http://reports.weforum.org/global-information-technology-report-2016/economies/#indexId=NRI&economy=BWA

[33] Central Intelligence Agency – The World Factbook. (2016). Botswana. Retrieved March 16, 2017 from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/bc.html

[34] The World Bank. (2015). Population ages 15-64 (% of total). Retrieved April 10, 2017 from http://data.worldbank.org/indicator/SP.POP.1564.TO.ZS?locations=BW

[35] Central Intelligence Agency – The World Factbook. (2016). Botswana. Retrieved March 16, 2017 from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/bc.html

[36] Central Intelligence Agency – The World Factbook. (2016). Botswana. Retrieved March 16, 2017 from https://www.cia.gov/library/publications/resources/the-world-factbook/geos/bc.html

[37] World Bank. (2013). CO2 emissions (metric tons per capita). Retrieved April 10, 2017 from http://data.worldbank.org/indicator/EN.ATM.CO2E.PC?locations=BW

[38] World Bank. (2013). Total greenhouse gas emissions (kt of CO2 equivalent). Retrieved April 10, 2017 from http://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE?locations=BW

significant water shortages and is dependent on neighbouring countries for inter-basin water transfers to add to its domestic supply.[39]

While there is still no climate change policy in effect, Botswana joined the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and is working on a national adaptation plan for the country.[40]

Botswana is one of Africa's most stable countries, and has Africa's longest continuous multi-party democracy. It is relatively free of corruption and has a good human rights record.[41]

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[39] UNDP. (2012). Botswana embarks on ambitious plan to tackle climate change. Retrieved May 28, 2017 from http://www.bw.undp.org/content/botswana/en/home/ourwork/environmentandenergy/successstories/botswana-embarks-on-ambitious-plan-to-tackle-climate-change-.html

[40] Daily News. (2016) Botswana: Climate Change Adaptation Plan Important. Retrieved May 27, 2017 from http://allafrica.com/stories/201610310223.html

[41] BBC. (2017). Botswana country profile. Retrieved April 12, 2017 from http://www.bbc.com/news/world-africa-13040376

2 Information and Communication Technology (ICT)

The telecommunications sector in Botswana has undergone various reforms since 1998 and the introduction of competition. Three public telecommunication operators provide local, international, national and mobile services.[42]

Botswana has created a converged communications regulatory environment by establishing the Communications Regulatory Authority Act of 2012 to replace the previous separate regulation of telecommunications and broadcasting (Telecommunications Act and the Broadcasting Act).[43] The Botswana Telecommunications Authority (BTA) was established as an independent regulatory body to create a communications regulatory environment in Botswana. The Communications Regulatory Authority Act (2012) merged BTA and National Broadcasting Board (NBB) into the Botswana Communications Regulatory Authority (BOCRA), launched in 2013. BOCRA has the authority to regulate and supervise all aspects of telecommunication common carriers and service providers, and sets industry standards, setting tariff principles and appropriate guidelines.[44]

Botswana Telecommunications Corporation (BTC) is the only fixed line operator in Botswana. There are three mobile operators in the market, namely Mascom, Orange and beMobile. The license for these operators authorizes them to provide national public telecommunication services over fixed or mobile, wire line or wireless, network links, using any available technology. In 2012, BTC was split into two separate entities: Botswana Fibre Networks (BoFiNet) which is responsible for backbone fibre infrastructure access and BTC, the retail fixed line operator.[45]

2.1 ICT Policy Frameworks

Botswana has developed plans, policies and strategies to harness the power of ICT to drive the socio-economic development of the country. These include Vision 2036, the National Development Plans (NDP 7–11), and the National ICT Policy known as Maitlamo.

Maitlamo, the National Policy for ICT Development, approved in 2007, built on government initiatives and aimed to assist in achieving Vision 2016 by serving as a catalyst in achieving social, economic, political and cultural transformation within the country. The vision of the policy states, "Botswana will be a globally competitive, knowledge and information society where lasting improvement in social, economic and cultural development is achieved through effective use of ICT."[46]

The policy development took into account that relatively few people in Botswana owned PCs or had access to the internet at home. The overall objectives of the ICT Policy are to assist the creation of an enabling environment for the growth of an ICT industry in the country, the provision of universal

[42] BOCRA. (no date). Telecommunications. Retrieved April 19, 2017 from http://www.bocra.org.bw/telecommunications

[43] BOCRA. (no date). History of Communication Regulation. Retrieved April 19, 2017 from http://www.bocra.org.bw/history-communication-regulation

[44] BOCRA. (no date). Telecommunications. Retrieved April 19, 2017 from http://www.bocra.org.bw/telecommunications

[45] IST Africa. (2016). Overview of ICT Infrastructure in Botswana. Retrieved March 10, 2017 from http://www.ist-africa.org/home/default.asp?page=doc-by-id-print&docid=2873&

[46] The Ministry of Communications, Science and Technology. (2007) National Information and Communications Technology Policy. Retrieved April 19, 2017 from http://www.bits.org.bw/wp-content/uploads/2016/05/Final-Revision-MCST-Maitlamo-Policy.pdf

service and access to ICT facilities in the country, and making Botswana a regional ICT hub to make the country's ICT sector globally competitive.[47]

Policy objectives include a culture of lifelong learning that maximizes the potential within all citizens and accelerates innovation to develop knowledge based system; electronic government services; increased economic diversification and foreign investment; access to information for all citizens; an ICT access point in every village; enhanced disease control and health care programmes; an efficient and cost-effective ICT infrastructure; and a clear ICT legal framework.[48]

Key programmes were designed to guide the National ICT Policy by providing a framework of how policy recommendations would be implemented. The recommendations include Connecting Communities Programme, Government-On-Line, Thuto Net, e-Health Botswana, ICT and Economic Diversification, Connecting Botswana, and Connectivity Laws and Policies. Some of the initiatives are discussed later in this report under ICT4D Initiatives.[49]

The Electronic Communications and Transactions Act of 2014 allows electronic transactions to be recognised in the same manner as paper-based transactions, the promotion of a legal framework to support electronic commercial practices and the promotion and adoption of information technologies in relation to electronic transactions. This act gives legal protection to domestic and international electronic transactions, increasing the value of ICT in economic trade.[50]

The Draft National Broadband Strategy (NBS), written by the government of Botswana and BOCRA in 2013, "aims at increasing the accessibility of broadband services throughout the country and improving its affordability". The strategy is being developed as a product and enabler of the implementation of other government policy initiatives, including the Economic Diversity Drive, Maitlamo and the e-Government strategy. The NBS recognises that the mechanism to achieve greater access to and affordability of broadband services is through increased competition.[51]

The Universal Access and Services policy has been under development for some time. BOCRA published a draft Universal Access and Service Fund Manual in April 2014. The vision of the Universal Access and Services Policy is that all Botswana will have affordable voice communications and access to internet and ICT services.[52]

2.2 ICT Infrastructure

Botswana has two diversified fibre links to South Africa, and radio links to Namibia, Zimbabwe and Zambia. There are also direct satellite links to UK, US, Canada as well as direct connectivity to London through SAT3 undersea cable. Botswana invested in fibre-optic networks locally and

[47] The Ministry of Communications, Science and Technology. (2007) National Information and Communications Technology Policy. Retrieved April 19, 2017 from http://www.bits.org.bw/wp-content/uploads/2016/05/Final-Revision-MCST-Maitlamo-Policy.pdf

[48] The Ministry of Communications, Science and Technology. (2007) National Information and Communications Technology Policy. Retrieved April 19, 2017 from http://www.bits.org.bw/wp-content/uploads/2016/05/Final-Revision-MCST-Maitlamo-Policy.pdf

[49] The Ministry of Communications, Science and Technology. (2007) National Information and Communications Technology Policy. Retrieved April 19, 2017 from http://www.bits.org.bw/wp-content/uploads/2016/05/Final-Revision-MCST-Maitlamo-Policy.pdf

[50] Republic of Botswana. (2014). Economic Communications and Transactions Act. Retrieved April 19, 2017 from http://www.bocra.org.bw/sites/default/files/documents/Electronic%20Communications%20and%20Transactions%20Act%202014.pdf

[51] BOCRA. (2013). Development of a National Broadband Strategy Project. Retrieved March 10, 2017 from http://www.bocra.org.bw/sites/default/files/documents/Phase%203%20Report%20V3%201%20%282%29.pdf

[52] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf

internationally to ensure effective communication infrastructure. These include NEPAD-Led Undersea Cable, East African Submarine System (EASSy), West African Festoon System and West Africa Coast Cable System (WACS).[53]

Figure 3   Botswana ICT network infrastructure[54]
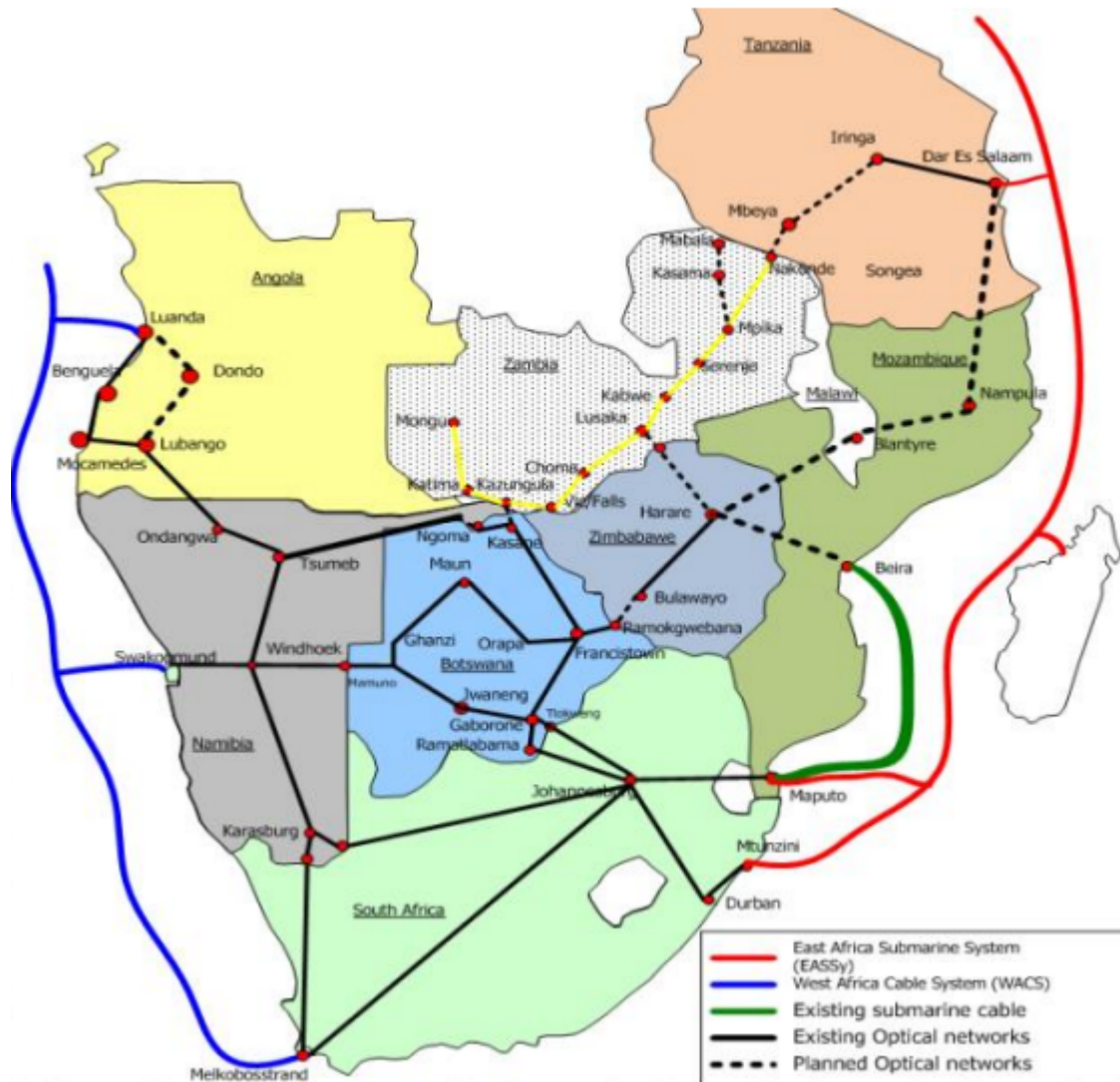
The National Backbone (TransKalahari Fibre Optic Ring) was installed in 2008 and funded by BTC. The cross-border fibre optic cable connections connect Botswana to South Africa, Namibia, Zambia and Zimbabwe. The National Backbone will ensure that an efficient telecommunications infrastructure reaches towns and villages. Botswana Power Corporation (BPC) has been rolling out an extensive rural electrification initiative since 2006. At the end of October 2008, over 52% households were connected to the national grid, and a total of 270 villages had been electrified. In order to meet the

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[53] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf

[54] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

increased demand for domestic electricity, an expansion of the Morupule B Power Station has been made to enable Botswana to meet the current and future of demands of the domestic market.[55]

Figure 4   Botswana national transmission network[56]
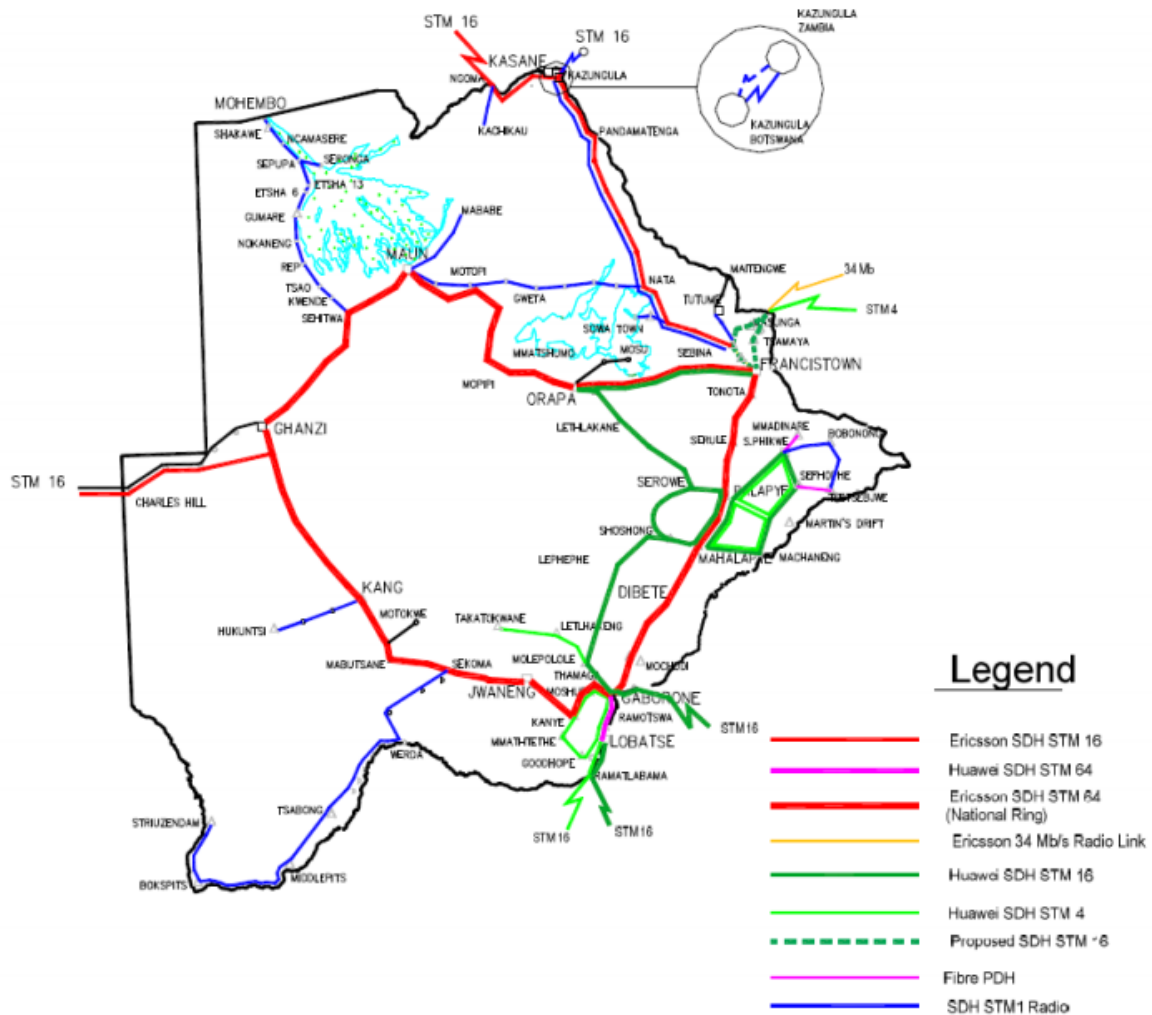
This figure shows the underlying key backbone of data communication is spread out throughout Botswana, but that there is still a challenge in that the fibre network runs mainly along the major highways on the western side of Botswana, which are relatively far away from remote and scattered communities, including schools and educational institutions. The biggest factor prohibiting connections to rural communities is the last-mile connection from the high-speed fibre links. This problem continues on the eastern side of the country where about 80% of the population has settled. Even schools that are just a few kilometres away from the fibre line are still not connected.[57]

[55] Joseph, SR. (2015). Overview of ICT for Developments (ICT4D) in Developing Countries: Botswana Case Study. Retrieved March 22, 2017 from https://www.researchgate.net/publication/270886131_OVERVIEW_OF_ICT_FOR_DEVELOPMENTS_ICT4D_IN_DEVELOPING_COUNTRIES_BOTSWANA_CASE_STUDY

[56] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[57] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

The Botswana government initiated Nteletsa II, which is a Rural Telecommunications Development Programme aimed at providing communities with access to telecommunications services. These include voice, data and internet services.[58]

One of the major steps the Botswana government followed was to delink the fibre network wholesale services from BTC, and engage a new independent company named BoFiNet. BoFiNet's mandate is to provide and operate a world-class telecommunications backbone network infrastructure that will drive connectivity and economic growth. It is fully sponsored by the government.

Cellular companies have invested in wireless technologies that reach out to remote communities. One of the three cellular private companies, beMobile, the subsidiary arm of BTC offers both data and voice services to individual subscribers and businesses. beMobile does not have any comprehensive agreement with the ministry to provide for the last-mile connection to schools despite being a subsidiary of BTC, which has recently ceased to be wholly own by the government. In 2009, Mascom was contracted by the Botswana government to provide telecommunications technology through the Nteletsa II Rural Telecommunications Development Project. During the project, Mascom extended coverage to a total of 41 villages and also set up Kitsong centres in all 41 villages.[59]

Orange was the first cellular service provider to launch the faster wireless technology called LTE or 4G in Botswana, and 4G has been launched in some major urban centres including Gaborone, Palapye, Francistown and Maun. Orange is also participating in the Nteletsa II project but has no specific agreement with the government to provide connectivity to schools, although the 4G technology can assist with the last mile connections.[60]

Botswana has had growth of mobile subscriptions of more than 100% since 2009. Mobile subscriptions increased from 3,095,894 in March 2013 to 3,204,869 in March 2014. The price of mobile internet has significantly decreased for both pre-paid and post-paid mobile services. The use of smartphones has led to increased number of people with access to the internet especially among the youth.[61] According to the BOCRA 2015 Annual Report, tele-density of mobile telephony was 168% in March 2015 and mobile internet penetration had increased from 49% in March 2014 to 59% in March 2015.[62]

[58] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[59] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[60] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[61] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[62] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf

Figure 5   Mobile cellular penetration per 100 inhabitants[63]

According to Botswana Communications Regulatory Authority, in 2015 there were 168,433 fixed phone lines subscriptions, 3.406 million mobile phone subscriptions and 34,435 broadband subscriptions.[64] The fixed-line subscriptions increased from 162,718 in March 2013 to 174,992 in March 2014, a growth rate of approximately 8%. Over a ten-year period, fixed line subscriptions grew by 28%. Uptake of ADSL remains low due to low uptake of fixed telephone lines.[65]
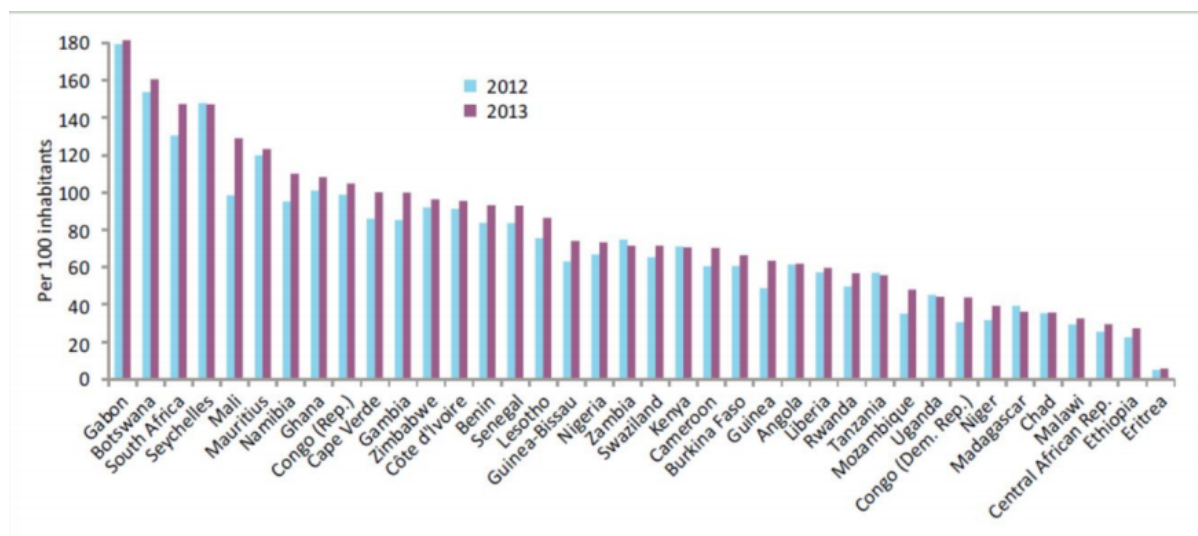
[63]   Botswana   IFAP   Committee.   (2016).   ICT   Literacy   Policy.   Retrieved   March   24,   2017   from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_ 9thifapcouncil.pdf
[64] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf
[65]   Botswana   IFAP   Committee.   (2016).   ICT   Literacy   Policy.   Retrieved   March   24,   2017   from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_ 9thifapcouncil.pdf

Figure 6   Internet users in Botswana[66]

Year	Internet Users**	Penetration (% of Pop)	Total Population	Non-Users (Internetless)	1Y User Change	1Y User Change	Population Change
2016*	492,787	21.4 %	2,303,820	1,811,033	6.2 %	28,978	1.83 %
2015*	463,809	20.5 %	2,262,485	1,798,676	12.9 %	53,121	1.92 %
2014	410,688	18.5 %	2,219,937	1,809,249	25.8 %	84,212	2 %
2013	326,477	15 %	2,176,510	1,850,034	33.1 %	81,202	2.05 %
2012	245,275	11.5 %	2,132,822	1,887,547	46.7 %	78,098	2.06 %
2011	167,176	8 %	2,089,706	1,922,530	36.1 %	44,307	2.04 %
2010	122,870	6 %	2,047,831	1,924,961	-0.5 %	-574	2.02 %
2009	123,444	6.2 %	2,007,212	1,883,768	0.4 %	452	2 %
2008	122,992	6.3 %	1,967,866	1,844,874	20.7 %	21,065	1.94 %
2007	101,927	5.3 %	1,930,431	1,828,504	25.3 %	20,604	1.83 %
2006	81,323	4.3 %	1,895,671	1,814,348	33.7 %	20,509	1.7 %
2005	60,814	3.3 %	1,864,003	1,803,189	0.2 %	145	1.54 %
2004	60,670	3.3 %	1,835,750	1,775,080	0.2 %	107	1.4 %
2003	60,563	3.3 %	1,810,438	1,749,875	0.1 %	67	1.33 %
2002	60,495	3.4 %	1,786,672	1,726,177	0 %	25	1.37 %
2001	60,470	3.4 %	1,762,531	1,702,061	20 %	10,063	1.49 %
2000	50,407	2.9 %	1,736,579	1,686,172	162.9 %	31,233	1.65 %

2.3 ICT4D Initiatives

An eGovernment strategy was launched in 2012 and coordinated by the Office of the President, with plans to provide most government services online. A government web portal with information and e-services was developed for customers, and making the organizational structure of government more transparent to citizens and businesses. Some ministries have call centres for customers to submit and enquire about basic information and services through toll-free numbers.[67]

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[66]   Internet Life Stats. (2016). Botswana Internet Users. Retrieved March 20, 2017 from http://www.internetlivestats.com/internet-users/botswana/
[67]   IST Africa. (2016). Current ICT Initiatives and projects. Retrieved March 10, 2017 from http://www.ist-africa.org/home/default.asp?page=doc-by-id&docid=5194

The eGovernment initiative services include mobile and e-notifications for a variety of ministries for purposes such as school registration, birth certificates, livestock tracking and passport applications, and access to examination results via mobile phone.[68]

Since government departments started implementing ICT separately, these systems became fragmented. In 2016, the Ministry of Transport and Communications (MTC) started construction of a blue print service-oriented enterprise architecture (SOEA) system aimed at modernising ICT in the public service. It was envisioned that the SOEA solution would take three years to develop. The SOEA system, which will cost P89 million, will replace the fragmented information systems developed by different ministries within the Botswana government.[69]

The Connecting Communities Programme focused on providing demand driven information relevant to the needs and conditions of the local people to connect communities in rural, remote and urban areas with affordable and accessible internet services. 197 communities were identified to be provided with network coverage under the Nteletsa II project. Communities were zoned based on geography and population. The zones have been divided into regional networks or "underserved areas" to provide an economy of scale, with the larger the area the greater the business that will allow operators to prosper and grow. This resulted in the creation of four underserved area, and the three mobile telephone service providers, Mascom, Orange and Botswana Telecommunications Cooperation (beMobile) were awarded tenders to provide telecommunication services in the four underserved areas.[70]

The Rural Telecommunications Programme targeted the provision of infrastructure services, including internet and telephone lines, in rural areas. Kitsong Centres were initially set up in 2006/2007 as community access centres as one of the Maitlamo ICT Policy Initiatives. These community access centres provide access to computers, fax, voice services and internet access as well as on-line business and government information and services.[71]

The concept of the Botswana Innovation Hub (BIH) started in 2008 along with development of Botswana's ICT infrastructure and Botswana Excellence Strategy to support economic diversification, job creation and transition to a knowledge economy. BIH is aimed at the following sectors through which businesses, research and training can be supplied: ICT, biotechnology, clean energy, mining technology, and indigenous knowledge. The BIH was developed to inspire and assist start-ups, provide an enabling environment for investors, and manage Botswana's first Science and Technology Park.[72] Programmes include the Microsoft Innovation Centre, First Steps Venture Centre (a technology entrepreneurship development and innovation commercialization programme), Mining Technology Entrepreneurship Centre, and the CleanTech Centre (in partnership with Lund University and Krinova Science Park in Sweden).[73] BIH offers services in the form of office space, land, state of the art telecommunications services, technology transfer services and entrepreneurship development. The government put tax incentives in place to encourage foreign investment.[74]

[68] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf

[69] All Africa. (2016). Botswana: MTC Develops Service Oriented E-Government System. Retrieved March 10, 2017 from http://allafrica.com/stories/201602180196.html

[70] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf

[71] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf

[72] Botswana Innovation Hub. (No Date). Botswana Innovation Hub Profile. Retrieved April 19, 2017 from http://www.bih.co.bw/bih-profile/

[73] Botswana Innovation Hub. (No Date). Programs. Retrieved April 19, 2017 from http://www.bih.co.bw/programs/

[74] Botswana Innovation Hub. (No Date). Services. Retrieved April 19, 2017 from http://www.bih.co.bw/services/

Botswana is a participant in the Pan African e-Network project, which is focused on connecting African countries as one network through satellite and fibre optic links for providing electronic and knowledge connectivity. The network provides tele-education, tele-medicine and VVIP service (for video conferencing and VoIP services). The project aimed to interconnect universities, learning centres, specialty hospitals and remote hospitals. Botswana identified three very small aperture terminal (Vsat) sites comprising a tele-education centre (learning centre) at the University of Botswana, a tele-medicine centre (patient-end-terminal) at a referral hospital and a VVIP location at the Office of the President.[75]

The Sesigo e-Public Libraries project is an initiative that the government of Botswana has implemented and is supporting, and is sponsored by Bill and Melinda Gates. The project, piloted in 2008, is aimed at providing free internet access and free computer training in libraries and reading rooms throughout the country. Librarians receive computer and internet training so that they can assist users. The project aimed to equip 78 of the country's 98 libraries by 2013, but no figures could be found for current implementation. Many of those who benefitted from the programme were first-time computer users. It was anticipated that over 70,000 members of the public would benefit from the programme, contributing to development and community engagement.[76]

2.4 Key Actors and Players

Actor/Player	Role and Area of Development
Ministry of Trade and Communication	Facilitates policy initiatives in the telecommunication and computing industry.
Botswana Telecommunications Authority (BTA)	Falls under Botswana's Ministry of Transport and Communications; mandated to promote the development and provision of efficient telecommunications and broadcasting services in Botswana.
Botswana Communications Regulatory Authority (BOCRA)	Regulator in the communication sector; establishes a transparent regulatory environment by setting certain standards, dispute resolution, setting tariffs and managing frequencies; issues licenses to ICT operators (fixed line, mobile, internet services).
Botswana Telecommunications Corporation (BTC)	State-owned enterprise incorporated under the BTC Act of 1980 (revised in 1996). Monopoly operator for landline provision, a wholesale backbone provider, a competitive data network provider as well as an ISP provider; provides public telecommunications services in Botswana.
Mascom	Leader in mobile phone communications. Offers internet services vide pre-paid and post-paid contracts, USB Modems
Orange	Mobile phone service provider in Botswana. Orange Botswana offers nationwide coverage consisting of radio coverage as well as GPRS/EDGE coverage.
beMobile	Mobile service provider owned by BTC
Botswana Fibre Networks (BoFiNet)	A wholesale provider of national telecommunication backbone network infrastructure

[75] Pan-African e-Network Project. (2016). About the Project. Retrieved March 10, 2017 from http://www.panafricanenetwork.com/Portal/ProjectDetails.jsp?projectidhide=12&projectnamehide=Overview
[76] Sesigo. (2010). Project Implementation Progress. Retrieved March 10, 2017 from http://www.sesigo.org.bw/index.php?id=49

2.5 Challenges in ICT Development

One of the major challenges in ICT development in Botswana is a lack of a synergized policy, legislative and regulatory regime which can encourage and facilitate a conducive and permitting environment for organizations and individuals to invest in and use ICT. Internet availability and the growth of e-commerce all are influenced by such policy and legislative alignments. The population at large is yet to benefit from various initiatives primarily due to lack of access to the internet due to the prohibitive cost structure. Lack of basic skills in operating ICT equipment is also a deterrent when it comes to usage and application of the same. Electricity continuity and connectivity is also a challenge in the rural areas. Botswana still needs to prepare itself in various areas such as relevant local content, universal service, human resources, affordable connectivity, access to adequate electricity supply, and the extent of the digital divide in order to leverage on ICT towards socio-economic development, although there are various on-going ICT initiatives in Botswana that are assisting in achieving a knowledge-based economy and society in Botswana.

One of the constraints resulting in such low internet usage is lack of computer access for the majority of the population. By virtue of a small population and low density, commercial gains and returns on high infrastructural set-up costs become very difficult and as a result the internet facilities remain unaffordable to a significant percentage of the population. Last mile connectivity also remains a constraint.

Inadequate electricity supply in the rural areas also proves to be a hindrance towards internet usage coupled with high costs of computer hardware. The rural population also lacks the ICT skills at large and also content adapted to their environment.

The overall trend in ICT development is encouraging and demonstrates that Botswana is beginning to understand and embrace the benefits of the networked economy and global information society and lay the infrastructure to become a connected country. However, despite major investments in infrastructure, Botswana is not yet making progress it needs to achieve to be the competitive in the connected world. This is emphasized in the overall global standings in national connectivity and e-readiness. Botswana's rankings have been dropping according to the World Economic Forum reports. Botswana needs to mobilize more effectively in its implementation and usage of ICT to realize the social and economic benefits of an effective digital economy and thriving Knowledge Society.[77]

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[77] Joseph, S.R. (2015). Overview of ICT for Developments (ICT4D) in Developing Countries: Botswana Case Study. Retrieved March 22, 2017 from https://www.researchgate.net/publication/270886131_OVERVIEW_OF_ICT_FOR_DEVELOPMENTS_ICT4D_IN_DEVELOPING_COUNTRIES_BOTSWANA_CASE_STUDY

3 Education

The Ministry of Education and Skills Development (MoESD) is responsible for basic education in Botswana, and has the mandate for curriculum development, recruitment of teachers and their administrative matters and provision of textbooks for the students and the teachers. On the other hand, the Ministry of Local Government holds the responsibility of providing school infrastructure and food services. Emphasis is placed on secondary education with continuous efforts to make it available to the entire population. The government invests substantially in providing this level of education in order to meet Botswana's human resource development demands which can narrow the gap between skills available and skill-sets required in all economic sectors.[78]

In 2016, the MoEST was split into the Ministry of Basic Education and Ministry of Tertiary Education, Research and Technology. The new Ministry of Tertiary Education, Research and Technology is responsible for policy on student financing, tertiary institutions, and coordinating research, science, and technology development. The 2017 budget has been cut by four percent from P11.6 billion. The Ministry of Basic Education has been allocated P6.8 billion while Ministry of Tertiary Education, Research and Technology would be given 4.3 billion.[79] It is unclear as yet how these ministries are operating and there is very little information currently available, therefore some of the information contained in this report may be outdated.

In Botswana, pre-school education is handled by the Ministry of Health in conjunction with the Ministry of Local Government for the first two stages. The final stage of pre-primary falls under the MoESD. The MoESD has adopted a strategy to take on a coordinating role of curriculum development. Pre-school education caters for children aged 0 to 6 which comprises of three levels: early stimulation of baby care (age 0 to 2.5 years), play school/day care (age 2.5 to 4 years) and pre-primary education (age 4 to 6).[80]

Early childhood care and development (ECCD) still remains the part of Botswana's education system that has the lowest participation rates, partly due to the fact that education policy has not singled out this level for rapid expansion in the way that was done with the primary level and the secondary level. NGOs and the private sectors basically run the ECCD sector. However, the current education policy, the Revised National Policy on Education (RNPE), has charged government with the responsibility of developing mechanisms for the coordination of this sector.[81]

The education sector has been shaped by two significant policy reforms, firstly in 1977 Education for Kagisano (Education for Social Harmony) and secondly in 1993 with Revised National Policy on Education (RNPE). The objectives of the MoESD include raising education standards across the country, to emphasize on Science and Technology in the education system, build and strengthen partnerships between schools and societies towards education development, to provide lifelong education, ensure strict control of the examination process and to achieve high levels of efficiency in

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[78] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf
[79] Mmegi Online. (2017). Gov't to slash tertiary education funding. Retrieved May 12, 2017 from http://www.mmegi.bw/index.php?aid=66183&dir=2017/january/27
[80] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf
[81] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

education development. The National Council on Education (NCE) holds the responsibility of formulating, implementing and monitoring of education policies.[82]

The RNPE was published in 1994. The goals of this current education policy are to prepare Botswana for the transition from a traditional agro-based economy to the industrial economy. It addresses issues of access, equity, and the improvement of the quality of education.[83]

The Education and Training Sector Strategic Plan (ETSSP) is a five-year medium term strategy 2015 to 2020 designed to transform education from pre-primary to tertiary level. To improve the learning outcome, the ETSSP plans to initiate activities that will work towards supporting teaching practices in the classroom. This will mean improving professionalism, teaching skills, subject content knowledge and ICT skills of teacher through life-long learning opportunities. A priority will be on improving attendance and accountability for appropriate use of time in school by teachers.[84]

Botswana has a 7-3-2 formal education structure, so primary school has a duration of seven grades; secondary school is divided into two cycles: lower secondary consists of grades 8 to 10, and upper secondary consists of grades 11 to 12. Primary and lower secondary are referred to as basic education. Lower and upper secondary are known as junior and senior secondary. Botswana has offered free primary education to all citizens, and primary and lower secondary schooling is compulsory. At the end of Grade 7, students write the Primary School Leaving Examination, at the end of Grade 10 they write the Junior Certificate Examination, and at the end of Grade 12 they write the Cambridge Overseas School Certificate Examination (GCE O-Level).[85]

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[82] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf

[83] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[84] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[85] Education Policy and Data Centre. (2014). Botswana. Retrieved April 19, 2017 from http://www.epdc.org/country/botswana

Figure 7   Education system and timeline in Botswana[86]
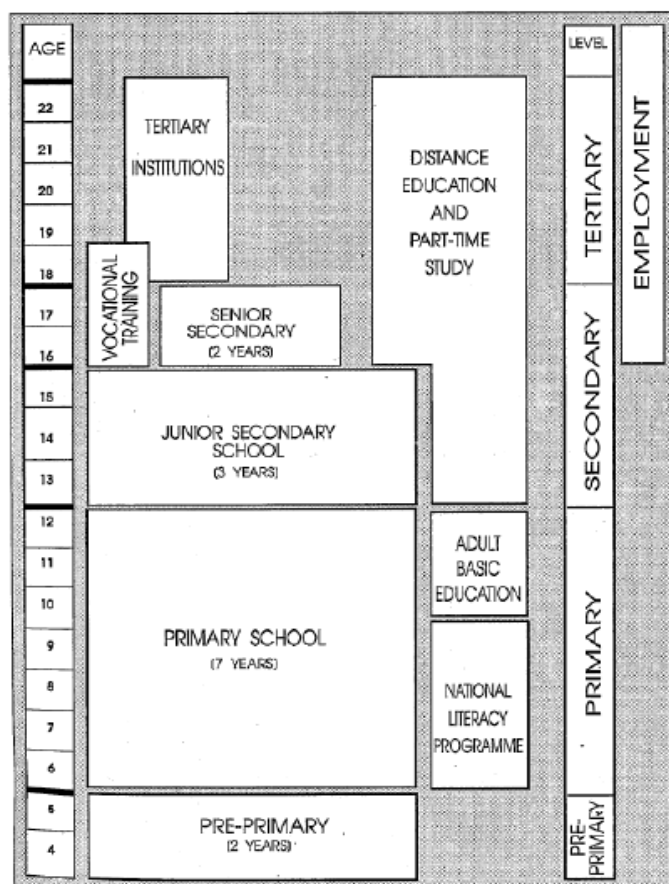
Setswana is the national language, with English and Setswana being the official languages for communication and instruction in educational and official communication. The population of Botswana speaks 27 languages other than Setswana, and the MoESD encourages mother tongue language use up until Standard 2, although with such diverse language groups, it is not always possible to find teachers speaking the same language as students.[87]

The Gross Enrolment Ratio (GER) and Net Enrolment Ratio (NER) are indicators used for measuring the education coverage in a nation. These ratios present an indication of the number of children who should be at school but are actually not in the learning system. GER is widely used to show the general level of participation in a given level of education whereas the NER shows the extent of participation belonging to the official age-group corresponding to the given level of education. These enrolment ratios give an idea of the number of children who should be at school but are actually not in the learning system.

[86] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf

[87] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf

Figure 8   Primary School GER and NER for 2003–2012[88]

Year	GER (6-12 Year) %	NER (6-12 Years) %	GER (7-13 Years) %	NER (7-13 Years) %
2003	114.6	90.0	114.5	98.7
2004	113.8	89.5	114.1	98.5
2005	113.1	89.6	114.1	97.8
2006	112.2	89.2	113.6	96.8
2007	109.4	86.9	111.5	94.9
2008	107.7	85.4	109.8	92.9
2009	108.4	85.8	109.8	91.8
2010	109.5	87.1	108.8	90.8
2011	112.7	90.6	98.6	88.4
2012	110.98	93.1	98.69	86.0

The GER of the age group 6-12 decreased from 114.5 in 2002 to 110.98 in 2012. The decrease in the GER over the years is an indication that the number of pupils enrolled outside the age ranges has been declining. The NER of 93.1 percent shows that only 93.1 percent of the population aged 6 to 12 were enrolled in primary schools in 2012. The general declining pattern of GER in this age group shows a positive response to the Revised National Policy on Education (RNPE) recommendation on school entry age of 6 years at primary school.[89]

Figure 9   Secondary School Gross and Net Enrolment Ratios: 2002–2012[90]

Year	Population Aged 13-17	Enrolment Aged 13-17	Total Enrolment	13-17 GER	13-17 NER
2002	200,833	118,146	155,207	77.3	58.8
2003	203,008	121,830	156,786	77.2	60
2004	204,787	123,146	158,839	77.6	60.1
2005	205,748	125,784	160,000	77.8	61.1
2006	206,208	128,183	164,201	79.6	62.2
2007	206,142	130,304	168,220	81.6	63.2
2008	205,601	134,954	172,868	84.1	65.6
2009	204,607	-	171,986	84.1	-
2010	-	-	-	-	-
2011	208683	135122	175910	84.3	64.7
2012	207,396	136,560	172,669	83.3	65.8

Note: (-) indicates unavailability of the indicator due to the unavailability of data.
2011Indicators are proxies drawn from the 2011 Census Data

GER and NER have been increasing since 2002. This is an indication of increased access to secondary education since 2002.[91]

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[88]Statistics Botswana. (2015). Education Statistics Report 2012. Retrieved Aprils 19, 2017 from http://www.statsbots.org.bw/sites/default/files/publications/Education%20Stats%202012.pdf
[89]Statistics Botswana. (2015). Education Statistics Report 2012. Retrieved Aprils 19, 2017 from http://www.statsbots.org.bw/sites/default/files/publications/Education%20Stats%202012.pdf
[90]Statistics Botswana. (2015). Education Statistics Report 2012. Retrieved Aprils 19, 2017 from http://www.statsbots.org.bw/sites/default/files/publications/Education%20Stats%202012.pdf
[91]Statistics Botswana. (2015). Education Statistics Report 2012. Retrieved Aprils 19, 2017 from http://www.statsbots.org.bw/sites/default/files/publications/Education%20Stats%202012.pdf

The Tertiary Education Policy (2008) which is known as 'Towards a Knowledge Society' is one of the strategies implemented towards attaining one of the pillars of the Vision 2016 being an educated and informed nation. It recognizes tertiary education as a driver for development.[92]

A second objective of the Tertiary Education Policy is to strengthen the Research and Innovation pillar of Knowledge Society which also forms part of the strategies under the Vision 2016 pillar of a prosperous, productive and innovative nation. Furthermore, tertiary education is acknowledged as a significantly contributing tool which will lead Botswana from a resource based economy to a knowledge economy.[93]

Botswana's tertiary education system has two major public universities the University of Botswana (UB) and the Botswana International University of Science and Technology (BIUST), established in 2011. There are 23 publicly-funded technical colleges. Colleges offering four-year degrees, masters degrees and professional qualifications include the Botswana Accountancy College (BAC) and the Botswana College of Agriculture (BCA); colleges of education offer a three-year diploma; vocational schools (known as brigades) offer certificate or diploma courses; technical colleges offer advanced certificates and diplomas in technical fields; and institutes for health sciences offer health-related non-degree qualifications. Training is provided by department-based colleges including the Police College, the Military School, the Roads Training Centre, and the Department of Environmental, Wildlife and Tourism Institute. Most public institutions are generally focused on meeting the human resource needs of the public sector, while the University of Botswana, in contrast, strives to be a regional and global university of international repute.[94]

Botswana has seven private higher education providers that enrol about 41% of the country's registered higher education students. The government of Botswana, as part of a joint public-private collaboration, subsidises private tertiary education and pays for students' tuition costs at private tertiary institutions. The growth in the number of tertiary education institutions has had a positive impact on access to education opportunities and also benefits the economy.[95]

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[92] Ministry of Education and Skills Development. (2008). Towards a Knowledge Society – Tertiary Education Policy. Retrieved on April 19, 2017 from http://www.ub.bw/ip/documents/2008_PolicywhitepaperapprovedGovernment%20of%20Botswana.pdf

[93] Ministry of Education and Skills Development. (2008). Towards a Knowledge Society – Tertiary Education Policy. Retrieved on April 19, 2017 from http://www.ub.bw/ip/documents/2008_PolicywhitepaperapprovedGovernment%20of%20Botswana.pdf

[94] Southern African Regional Universities Association. (2012): A profile of Higher Education in Southern Africa. Retrieved on April 19, 2017 from http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/SARUA%20Profiles%20of%20HE%20Vol%202.pdf

[95] Southern African Regional Universities Association. (2012): A profile of Higher Education in Southern Africa. Retrieved on April 19, 2017 from http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/SARUA%20Profiles%20of%20HE%20Vol%202.pdf

Figure 10 Tertiary education gross enrolment rates (%) for 2003/2004 to 2009/2010[96]
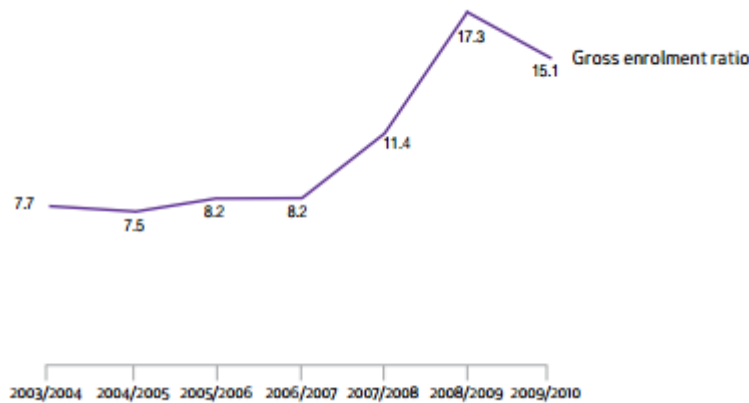
Figure 11 Number of students per major field of study and gender
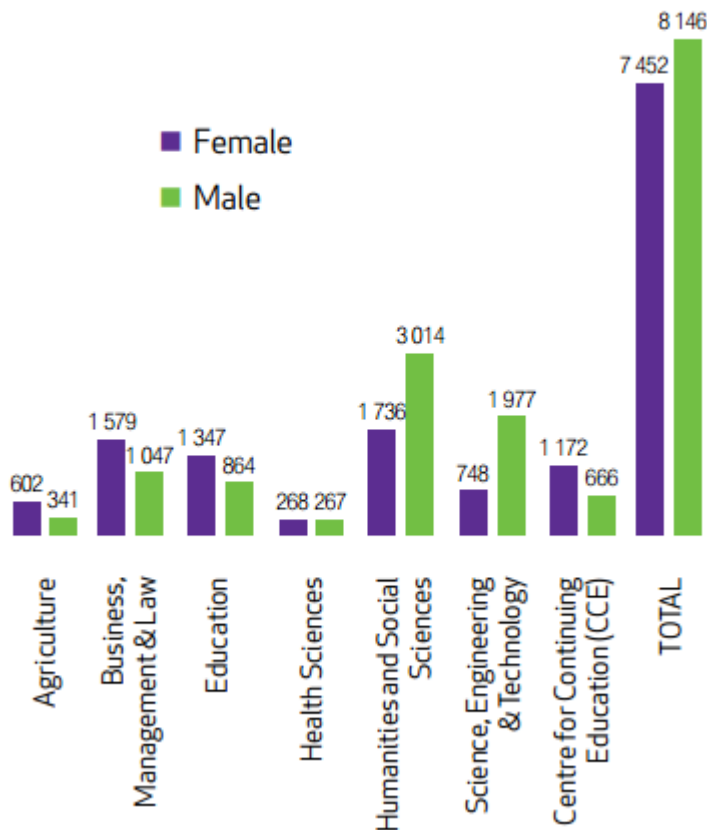
Historically, the Technical, Vocational and Education and Training (TVET) structure in Botswana was known to be less developed compared to the academic education. It has been found that students who undertook TVET courses reached a juncture of no further progress due to financial investment challenges. In a bid to create future opportunities for such students and youth, the Botswana

[96] Southern African Regional Universities Association. (2012): A profile of Higher Education in Southern Africa. Retrieved on April 19, 2017 from http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/SARUA%20Profiles%20of%20HE%20Vol%202.pdf

Technical Education Programme (BTEP) was established in 2001 by the then Ministry of Education. This is a college based programme offering project roles, work placements and internships with industries. The BTEP prepares the youth for further education and employment.[97]

The mandate for vocational education training is held jointly by the MoESD and Ministry of Labour and Home Affairs. Technical training is offered by various ministries, the private sector and parastatals. The Department for Vocational Education Training (DVET) within the MoESD handles this TVET portfolio and apprenticeships are also coordinated by DVET through institutions like government vocational education centres and community-based training schools called brigades.[98]

An outcome of the Revised National Policy on Education (RNPE) in 1998 was the creation of the Botswana College of Distance and Open Learning (BOCODOL) which is a statutory institution. BOCODOL was established in 2000 and offers basic education courses at Junior Certificate Examination (JCE), Botswana General Certificate of Secondary Education (BGCSE) level and various diploma and degree programmes through a distance learning option. This open distance learning method of teaching was initiated to offer an alternative schooling option to those youth and adults who, for various reasons, missed out on secondary education. The e-learning method of education offered by BOCODOL facilitates national human resource development with training opportunities in remote centres nationally.[99] Such institutions form part of the informal education sector which are just as significant to implement broader societal learning which is considered as necessary in development towards a Knowledge Society.

The Government of Botswana set up the Botswana Training Authority (BOTA) with a mandate of regulating vocational training institutions. BOTA handled registration of all training institutions which must meet minimum requirements with regard to trainers, budgets, student capacity and facilities offered for training. BOTA handled a vocational training fund and also handled recruitment of trainers and assessors.[100]

The Government of Botswana has established the Botswana Qualifications Authority (BQA) through the enactment of the Botswana Qualifications Authority Act, No 24 of 2013.The BQA commenced operations in 2013. Botswana Training Authority (BOTA) continued under the new name of the Botswana Qualifications Authority (BQA). The BQA objectives are to provide for and maintain the National Credit and Qualifications Framework (NCQF) and coordinate the education, training and skills development quality assurance system from early childhood to tertiary level.[101]

In 2017, it was announced that BQA is to assess the entire education system pipeline from early childhood to tertiary level. BQA was established to quality assure education and training from early childhood to higher education, across the three levels of General Education, Technical and Vocational Education and Training (TVET) and Higher Education.[102]

[97] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf

[98] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf

[99] Botswana College of Distance and Open Learning. (2016). About Us. Retrieved May 12, 2017 from http://www.bocodol.ac.bw/index.php/about-us

[100] UNESCO/UNEVOC. (2010). Integrating Sustainable Development in Technical and Vocation Education Training. Six Case Studies from Southern and East Africa. Retrieved on May 12, 2017 from http://www.unevoc.unesco.org/fileadmin/user_upload/docs/CS_vol2_ESD_Africa_Final.pdf

[101] Botswana Qualifications Authority. (No Date). Profile. Retrieved May 12, 2017 from https://www.bqa.org.bw/profile

[102] The Voice. (2017). BQA to assess whole education system. Accessed April 19, 2017 from http://thevoicebw.com/bqa-assess-whole-education-system/

3.1 ICT in Education

The MoEST is introducing ICT into the education sector through the implementation of the Thuto Net component as part of the national Maitlamo Policy on ICT. The MoESD is working through the Thuto Net initiative to support education and ICT through networking and e-learning platforms. Efforts have largely been geared towards the provision of computers in schools. Access ratio in both primary and secondary schools is very low. In some primary schools, there are hundreds of pupils who share two, three, or four computers that are available and functioning in the whole school.[103]

The Thuto Net programme was designed to link all secondary schools to the internet. All secondary schools in Botswana have computer laboratories with up to 20 computers. This initiative was aimed at reducing literacy gaps between students in urban schools and rural schools. As part of the programme, teachers received training on using ICT as a classroom tool.[104] In 2016, 104 secondary schools, out of a total of 235, throughout the country had internet access and the programme is rolling out to other secondary schools.[105]

The little that has been done to implement ICT in schools has focused on simply providing schools with a limited number of computers without a clear implementation strategy for their use in education. The Education and Training Sector Strategic Plan (ETSSP) for 2015–2020 provides a clear purpose and rationale for how the Thuto Net component of the national policy will be effectively integrated into the sector, including identifying opportunities, issues, challenges and strategies that will be employed. The aim will be to manage the integration of ICT in a strategic and coordinated way.[106]

The ETSSP will support the implementation of the Thuto Net component of the national Maitlamo policy, including providing schools with high speed internet access, increasing computer to student ratio in schools, designing and implementing an ICT content and curriculum development programme for primary, secondary, vocational and tertiary schools, designing and implementing a professional development programmes to increase ICT capacity building for teachers, amongst others.[107]

The Computers for Schools (CFS) Programme will look at the feasibility of government and private sector organizations donating surplus computers for use in schools and communities. The use of recycled computers provides on-the-job experience for recent IT graduates working in specialized refurbishing/training centres. School-based computer repair workshops can also be incorporated

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[103] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[104] IST Africa. (2016). Report on ICT Initiatives and Research Capacity in IST-Africa Partner Countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_ICTInitiatives_ResearchCapacity_v2_310116.pdf

[105] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[106] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[107] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

into the general curriculum providing real-world skills and entry-level employment opportunities for students.[108]

In 2013/14, BOCRA started a needs assessment exercise in Botswana to promote access to ICT services. The education sector was identified as a critical sector requiring access to ICT. A survey conducted by BOCRA showed that internet speed in schools is slow or completely non-existent, some schools used outdated computers, the ratio of student to computer in schools is high, and that computer laboratories were often 'un-serviced'. BOCRA has engaged the Ministry of Education and Skills Development to support their Thuto Net initiative. Schools in Botswana use radios, televisions, telephones and computers to deliver ICT in education. In 2013, of all the schools in Botswana, 60% of schools used radios, 61% used televisions sets, and 88% of schools had telephones. In 2013, for every 100 students there were only eight computers available for them.[109]

Figure 12 ICT in education services across schools, 2013[110]

	Proportion	Percentage
Schools with radios	0.6	60
Schools with TV	0.61	61
Schools with telephone	0.88	88
Students computer ratio	0.08	8
Schools using narrow band internet	0.24	24
Schools using fixed broad band internet below 256kbits/s	0.04	4
School using mobile broad band internet	0	0
Students with access to the internet at school	0.47	47
ICT qualified teachers in primary and secondary school	0.05	5
Schools with electricity	0.89	89

Source: Ministry of Education

Video has played a role in higher education, particularly in the university sector, but has not been widely used in primary and secondary education networks. A video conferencing solution pilot, offered by Dimension Data, will be carried out in a number of schools in Southern Botswana. Schools are connected simultaneously via video, and lessons are delivered to pupils from a single point. Video conferencing can also add to professional development for staff and enable students to interact with their peers from other schools. The video conferencing technology will offer teachers the ability to learn new teaching techniques and the ability to experiment using new technologies.[111]

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[108] The Ministry of Communications, Science and Technology. (2007) National Information and Communications Technology Policy. Retrieved April 19, 2017 from http://www.bits.org.bw/wp-content/uploads/2016/05/Final-Revision-MCST-Maitlamo-Policy.pdf

[109] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[110] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[111] Botswana Guardian. (2016). Video conferencing essential in schools. Retrieved April 19, 2017 from http://www.botswanaguardian.co.bw/news/item/2045-video-conferencing-essential-in-schools.html

In the vast majority of primary schools in Botswana, there is no ICT literacy or computers. In junior secondary schools the Computer Awareness course is not compulsory and there is no examination.[112]

The government of Botswana is committed to increasing the ICT uptake in the country. Botswana's ICT infrastructure is very good, but is not fully utilised. Internet usage, for example, stands as low as 10% of the population. There is also considerable disparity in terms of urban and rural access to ICT services.[113]

The government expanded both infrastructure and services to guarantee every child of school-going age ten years of basic education, including an ICT component, by introducing computer education at all levels, set up computer labs in all secondary schools, refurbishing of computers for distribution to primary schools, and making sure that all secondary schools have broadband connectivity. However, schools face many challenges with regards to infrastructure. Some do not have suitable rooms with enough power sockets and network points. Others are not connected to electricity, and connectivity is also a challenge as some of the schools are in very remote areas. Another challenge is the lack of adequate training and exposure to the ICT environment for teachers and school leadership. The skills required to fully utilize ICT are beyond the competencies they acquired from the short in-service courses. There is limited time allocation for the teaching of the computer awareness programme and these is little integration of ICT into learning and teaching processes.[114]

3.2 Curriculum

The Department of Curriculum Development and Evaluation (CDE), within the MoESD, develops and administers the national curriculum. The CDE has the overall responsibility for providing leadership in improving the quality of education through curriculum development, review and revision. It directs, coordinates and monitors curriculum review for basic and senior secondary education in the country, as well as planning and developing instructional materials supporting the implementation of the curriculum. Instructional materials including prescribed student textbooks, teacher's guides, and supplementary materials for each grade and are used to explain the curriculum. Textbooks are developed by independent publishing companies and assessed by a Book Review Committee, and evaluated by the CDE. The CDE recommends textbooks and schools can choose textbooks from a list of approved titles. The CDE has created a booklet for junior secondary school teachers providing support on the development of instructional materials, teaching and learning methodologies, gender-sensitive content issues, and language use.[115]

The ministry aims to facilitate effective ICT curriculum implementation and assessment. As a makeshift measure, the government has resolved to strengthen policy environments and improve teacher training in new pedagogies linked to the use of ICT, provide relevant and up-to-date learning and support materials, such as software and textbooks, and the provision of resources and

[112] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[113] Biztech Africa. (2015). Botswana commits to spreading ICT in schools. Retrieved April 19, 2017 from http://www.biztechafrica.com/article/botswana-commits-spreading-ict-schools/9472/

[114] Biztech Africa. (2015). Botswana commits to spreading ICT in schools. Retrieved April 19, 2017 from http://www.biztechafrica.com/article/botswana-commits-spreading-ict-schools/9472/

[115] TIMMS & PIRLS. (2016). Botswana. Retrieved May 17, 2017 from http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/botswana/teachers-teacher-education-and-professional-development/

equipment at school level for improved monitoring and support.[116] Out of the 19 subjects offered at senior secondary schools, only seven infuse ICT into their delivery. That is, only 37% of subjects integrate ICT into their teaching and learning activities. Thuto Net recommends that ICT be introduced to learners at the earliest possible age and formalised into the general curriculum so that learners acquire ICT skills throughout their academic development.[117]

The ETSSP will support the implementation of the Thuto Net component of the national Maitlamo policy through the five thematic programmes from early childhood to tertiary and vocational educations. These are: lifelong learning, ICT, curriculum development, human resource development, and Education Management and Information System reform (EMIS).[118]

3.3 Professional Development

The Teaching Practice Office at the University of Botswana is the liaison between the University of Botswana and all stakeholders involved in teacher training and development. Activities are coordinated with the faculty, other faculties with students intending to become teachers, the Ministry of Education and Skills Development, and the schools where the student teachers train. Teaching practice is the connection between theory in practice and the incorporation of new teaching strategies and innovations.[119]

Teachers in Botswana are required to complete a three-year diploma course at a primary college of education or at a secondary college of education to teach in a primary school or a junior secondary school, respectively. In primary colleges of education, half the course time is spent on subject content and half on pedagogy. Universities also offer further studies for qualified teachers. Subject specialization currently applies to teachers at the secondary level only. Primary teachers teach all the subjects, although some are educated as specialist teachers. Many teachers in Botswana have been sent for further studies and replaced temporarily by inexperienced teachers.[120]

The Department of Training and Development, within the Ministry of Education and Skills Development, is mandated to provide professional development to teachers. There is a Training and Development officer in each of Botswana's ten regions. The Training and Development department is experiencing a shortage of officers, impeding the success of its programme, and many teachers do not participate in professional development activities.[121]

A programme called Strengthening of Mathematics and Science in Secondary Education (SMASSE) was introduced in 2006 to strengthen and improve the quality of performance, teaching, and learning of mathematics and science in secondary schools. The programme covers four basic

[116] UNESCO. (2011). World Data on Education – Botswana 7th edition. Retrieved on April 19, 201 from http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Botswana.pdf
[117] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf
[118] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf
[119] University of Botswana. (No Date). Teaching Practise. Retrieved May 12, 2017 from http://www.ub.bw/home/ac/1/fac/11/dep/62/teaching-practise/
[120] TIMMS & PIRLS. (2016). Botswana. Retrieved May 17, 2017 from http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/botswana/teachers-teacher-education-and-professional-development/
[121] TIMMS & PIRLS. (2016). Botswana. Retrieved May 17, 2017 from http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/botswana/teachers-teacher-education-and-professional-development/

principles that guide SMASSE in-service teacher training activities: Plan, Do, See, and Improve (PDSI).[122]

In 2015, BOCODOL began to integrate ICT into teaching and learning. It has been working on capacitating staff members to create new, and adapt existing print-based programmes, courses for access using e-learning technologies. Its focus is on planning an online course, instructional design to support online learning and learner management system (LMS) technical skills. BOCODOL has converted some courses to support e-learning from a programme in the Department of Teacher Education in the School of Education. The college aims to attain Open University status, offer 40 programmes, increase its annual enrolment of 14,000 and cumulative enrolment of 84,000 by 2018.[123]

3.4 Key Actors and Players

Actor/Player	Role and Area of Development
Ministry of Education and Skills Development	Overall responsibility of achieving goals of basic education; responsibility of primary and secondary Education - curriculum development, recruitment of teachers and their administrative matters, provision of textbooks
Ministry of Tertiary Education, Research, Science and Technology	A new ministry responsible for policy on student financing, tertiary institutions and coordinating research, science and technology development
Ministry of Local Government and Rural Development holds	Responsible for providing school infrastructure and food services
University of Botswana	Established in 1982 as the first institution of higher education in Botswana; state-owned university which offers academic and professional training
Botswana International University of Science and Technology (BIUST)	State-owned university which offers academic and professional training
Botswana College of Distance and Open Learning	Statutory institution which offers basic education courses at JCE, BGCSE level and various diploma and degree programmes through a distance learning option to out-of-school youth and adults
Botswana Qualifications Authority (BQA)	A parastatal under the Ministry of Tertiary Education, Research, Science and Technology established to improve the quality of education and training in Botswana from early childhood to tertiary

3.5 Challenges facing the education sector

Cultural and language barrier in the early stages of schooling is also a challenge in Botswana. The education policies cater for two languages being English and Setswana however teaching in these languages at to entry level school going children is a challenge for children who are only fluent in

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[122]   TIMMS   &   PIRLS.   (2016).   Botswana.   Retrieved   May   17,   2017   from http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/botswana/teachers-teacher-education-and-professional-development/

[123] Botswana College of Distance and Open Learning. (2015). BOCODOL Integrates ICT's Into Teaching And Learning. Retrieved May 26, 2017 from http://www.bocodol.ac.bw/index.php/press-room/news/item/132-bocodol-integrates-ict-s-into-teaching-and-learning

their mother-tongues. There is also a cause for concern in the shortage of teachers who are fluent in some local vernacular languages, especially in the disadvantaged minority groups.

Policies relevant to ICT in education have been put in place, but they focus more on the ICT accessibility and availability of the basic resources, such as computers in schools and internet access and not on the pedagogical significance and best practices of ICT in other subjects in school.[124]

Botswana has a robust telecommunications backbone infrastructure, complemented by mobile phone companies in providing fast wireless technologies, and a high mobile phone penetration rate. Unfortunately, the excellent infrastructure and high mobile phone penetration have not translated into the effective use of ICT in schools because connectivity and its cost remains a major challenge.[125]

Teaching of ICT at primary schools is inconsistent and not compulsory. Teaching of ICT at Junior Secondary schools is significantly more than at primary but the Computer Awareness course taught at junior schools is not compulsory. Even more of a challenge is the lack of use of ICT to support the pedagogy and delivery of other non-ICT subjects.[126]

The emergence of the Education and Training Sector Strategic Plan (ETSSP) provides the opportunity to provide a clear purpose and rationale for how the Thuto Net component of the national policy will be effectively integrated into the sector, including identifying opportunities, issues, challenges and strategies that will be employed. This strategic plan remains the hope for the MoESD to implement full utilization of ICT in teaching and learning.[127]

[124] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[125] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[126] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

[127] Botswana IFAP Committee. (2016). ICT Literacy Policy. Retrieved March 24, 2017 from http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/ifap/meetings/council/ifap_botswana_ict_literacy_report_9thifapcouncil.pdf

4 Science, Technology, and Innovation (STI)

In Botswana, the Science Technology and Innovation (STI) portfolio falls under the Ministry of Infrastructure, Science and Technology (MIST). The core mission of this Ministry is to 'deliver quality building infrastructure, promote socio-economic oriented technological research, and the safe application of nuclear technology, in partnership with its stakeholders to enhance economic diversification and efficiency'.[128]

The Ministry hosts four departments, namely the Department of Research, Science and Technology (DRST), Corporate Services (administrative and support service), the Department of Building and Engineering Services (DBES) and Radiation Protection Inspectorate (safe use of atomic energy and nuclear technology).[129]

The Department of Research, Science and Technology (DRST) is mandated to provide and facilitate adequate policy and legislative framework with effective leadership which enables the development and coordination of RST activities in Botswana. Their mission is to develop globally recognized RST systems with a bid towards economic prosperity of the country.[130]

The Department of Building and Engineering Services (DBES) holds the responsibility of government building and development projects, and respective and required infrastructure, engineering services together with the maintenance function of these buildings and infrastructure. In 2003, the former Department of Architecture and Building Services (DABS) and the Department of Electrical and Mechanical Services (DEMS) were merged to form the DBES.[131]

4.1 STI Policies and Objectives

Botswana established a National Science and Technology Policy in 1998 through which all Science and Technology related developments could be coordinated. This policy was later revised during 2011 and a new Research, Science, Technology and Innovation Policy was approved by Cabinet and launched in 2012 to respond to the rapid technological evolution, globalisation, and national development goals as outlined in Vision 2016, National Development Plans and Millennium Development Goals.[132]

In 2011, the Department of Research, Science and Technology reviewed implementation of the Science and Technology Policy, and initiated a review to align it with other major strategic frameworks, such as Botswana's Vision 2016, NDP 10 and the United Nations' Millennium Development Goals. This process resulted in a new National Policy on Research, Science, Technology and Innovation in 2011. The new policy aims to address to the challenges of rapid technological evolution, globalization and the achievement of the national development goals, and focuses on

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[128] Ministry of Infrastructure, Science and Technology. (2010). About MIST. Retrieved March 10, 2017 from www.mist.gov.bw:80/index.php?option=com_content1&parent_id=184&id=360

[129] Ministry of Infrastructure, Science and Technology. (2010). Departments. Retrieved March 10, 2017 from http://www.mist.gov.bw:80/index.php?option=com_content1&id=416&parent_id=0

[130] Ministry of Infrastructure, Science and Technology. (2010). Departments. Retrieved March 10, 2017 from http://www.mist.gov.bw:80/index.php?option=com_content1&id=416&parent_id=0

[131] Ministry of Infrastructure, Science and Technology. (2010). Departments. Retrieved March 10, 2017 from http://www.mist.gov.bw:80/index.php?option=com_content1&id=416&parent_id=0

[132] IST Africa. (2016). Introduction – Republic of Botswana. Retrieved March 10, 2017 from http://www.ist-africa.org/home/default.asp?page=doc-by-id-print&docid=5195&

growing the ICT industry, making Botswana a regional ICT hub, e-government, education innovation, e-health and technology infrastructure.[133]

The National Research, Science and Technology Plan (2005) emphasized the need to effect research and technology development (RTD) and innovation cooperation through the Framework Programme for RTD, focus on capacity-building, and make use of various technology platforms and partnerships. ICT is highlighted as a key tool for achieving the plan's development objectives. The Department of Research Science and Technology (DRST) provides leadership in science and technology in Botswana on behalf of government. Botswana Institute for Technology Research and Innovation (BITRI), a parastatal under the Ministry of Infrastructure, Science and Technology, conducts needs-based research and development in focused areas in accordance with national priorities.[134]

The idea of research and innovation as a driver of Botswana's development agenda was further advanced through the National Development Plan 10 (2009–2016) with 'Knowledge Society' being identified as one of the key result areas. The focus areas include the strengthening of R&D with a requirement of research institutions to 'intensify creativity and innovation and produce commercial commodities which will benefit society'. [135]

[133] UNESCO. (2013). Mapping Research and Innovation in the Republic of Botswana. Retrieved May 12, 2017 from http://unesdoc.unesco.org/images/0022/002247/224725E.pdf

[134] IST Africa. (2016). Introduction – Republic of Botswana. Retrieved March 10, 2017 from http://www.ist-africa.org/home/default.asp?page=doc-by-id-print&docid=5195&

[135] IST Africa. (2016). Report on Innovation Spaces and Living Labs in IST-Africa Partner countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_InnovationSpaces_LL_v2_310116.pdf

Figure 13 Contribution of the National Policy on Research, Science, Technology and Innovation to national development goals, according to Vision 2016 [136]
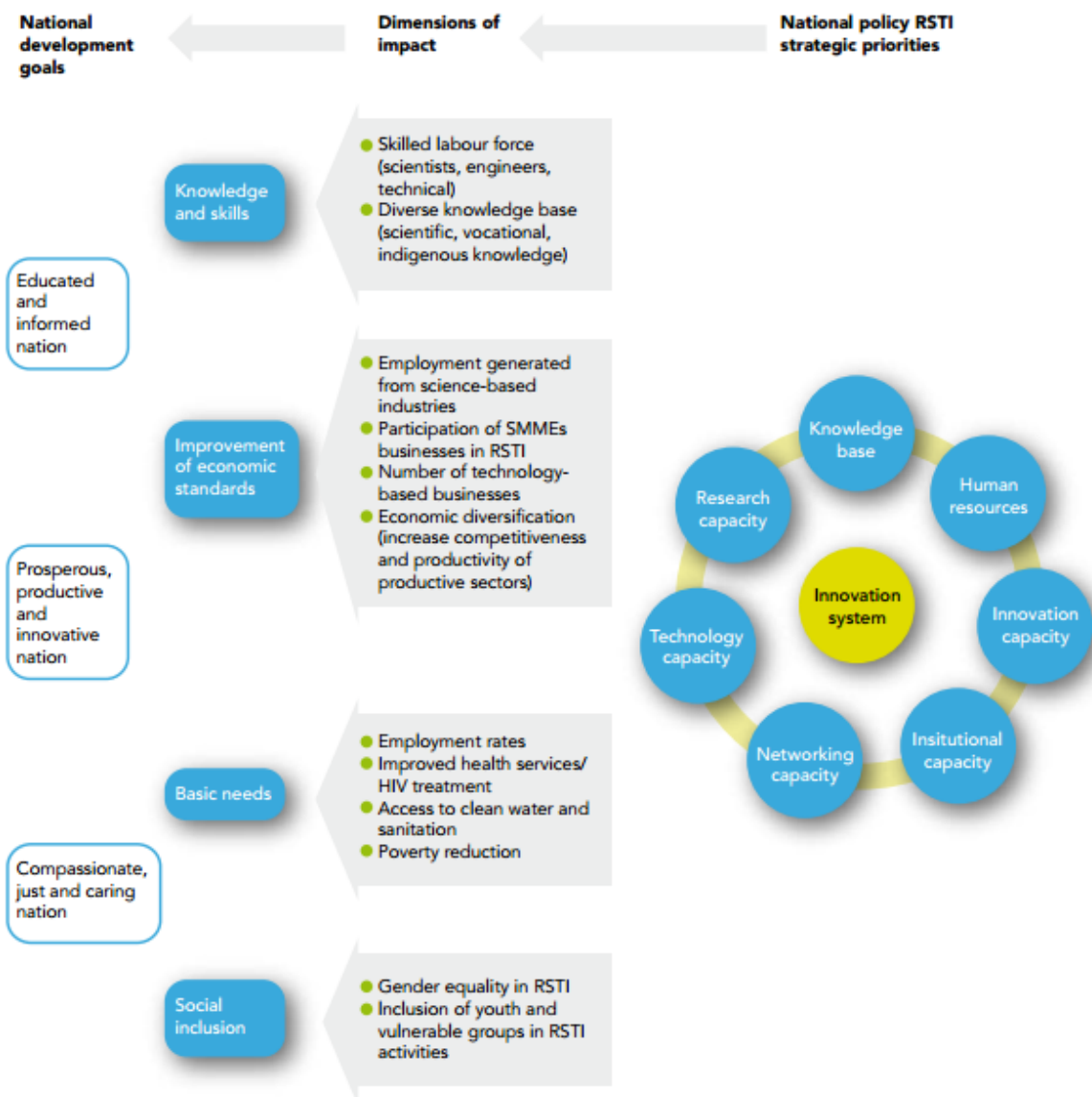
4.2 Research and Innovation

To address shortage of science, technology and engineering expertise, the government of Botswana has established a number of organizations and parastatals to advise the government on science and technology policy formation and also to provide research to come up with innovative solutions to economic growth challenges.

Botswana Institute of Technology Research and Innovation (BITRI) is a parastatal under the Ministry of Infrastructure Science and Technology, established in 2012 to conduct needs-based research and development in focused areas. The mandate of BITRI is to identify and/or develop

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[136] UNESCO. (2013). Mapping Research and Innovation in the Republic of Botswana. Retrieved May 12, 2017 from http://unesdoc.unesco.org/images/0022/002247/224725E.pdf

appropriate technology solutions that provides sustainable innovative solutions through co-creation and collaboration in line with national priorities and needs of Batswana.[137]

Its research and development portfolio is organized into two major research areas: technologies, which includes electronics, energy and ICT, and natural resources and materials, which includes building materials, environment and climate change, and nanomaterials. Examples of specific technologies developed under these programmes are:

- Kgalagadi Sand Building Block/Brick (KSBB) Technology, which is used to develop the Kgalagadi Sand Building Block and rolling out the more cost-effective product with much higher strength, and a useful construction material;
- Design and development of solar powered low cost PC for primary and secondary schools even those at remote areas where electricity is a challenge;
- Wi-Fi integration to solar-powered Seding light to benefit rural citizens where electricity and internet connectivity is a challenge;
- Research on solar photovoltaic, solar thermal and wind energy technologies;
- Clean coal technologies, biofuels and coal to liquid technologies;
- Development of risk management strategies and decision support tools for dryland farmers in desert areas of Botswana;
- Rainfall measurement through mobile networks to improve availability, access and use of climate information;
- The development of a gravity-based water filter product to enable Batswana in remote areas to access safe drinking water;
- The development of improved air filtration devices to reduce the dependence on imported products; and
- The development of a rapid diagnostic tool for foot-and-mouth disease.[138]

Botswana Innovation Hub (BIH) is located in Gaborone and seeks to offer a global standard of telecommunications infrastructure with paramount connectivity, business services and business development services to technology-driven and knowledge intensive businesses. It sets to target and welcome organizations dealing with mining technologies, ICT structures and biotechnology.[139]

The Botswana Innovation Hub offers a platform for scientific, technological and indigenous knowledge-based innovation. Botswana Innovation Hub supports the growth of techno-rich business enterprises over the long term to increase the wealth of the local knowledge intensive community, promote a culture of innovation, and stimulate the competitiveness of member companies and knowledge based institutions.[140]

When fully developed, the Science and Technology Park, under the BIH, will consist of world class facilities including state-of the- art telecommunications infrastructure with high capacity international connectivity and secured power, professional business services, and business development services. The BIH key focus sectors are Information Communication Technology, Biotechnology, Mining Technology and Clean Technology.[141]

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[137] Botswana Institute for Technology Research and Innovation. (No Date). Corporate Profile. Retrieved April 19, 2017 from http://www.bitri.co.bw/about-us/

[138] Botswana Institute for Technology Research and Innovation. (2016). 2014/2015 Annual Report. Retrieved April 19, 2017 from http://www.bitri.co.bw/wp-content/uploads/2016/03/bitri_annual_report_2015.pdf

[139] Botswana Innovation Hub. (No Date). Services. Retrieved April 19, 2017 from http://www.bih.co.bw/services/

[140] Weekend Post. (2017). Botswana has a mere 200 scientists! Retrieved May 12, 2017 from http://www.weekendpost.co.bw/wp-news-details.php?nid=3714

[141] Weekend Post. (2017). Botswana has a mere 200 scientists! Retrieved May 12, 2017 from http://www.weekendpost.co.bw/wp-news-details.php?nid=3714

As mentioned earlier, Botswana is currently trying to diversify its economy. One of the prongs of this approach to attract international research units and software companies to base themselves in the Botswana Innovation Hub is a signal of the strategic positioning the government is taking to increase the level of research maturity of the country. One of the key challenges is the small number of research institutions. While the current primary focus is on technology adoption and developing applications, there is a strong policy focus on further strengthening the research capacity within the country, and especially in facilitating the continued development of post-graduate programmes and involvement in cross-border research.[142]

Botswana Institute for Development Policy Analysis (BIDPA) is an independent trust and non-governmental policy research institution. The two key areas of BIDPA's mandate are development policy analysis and capacity building. Its aim is to promote policy analysis through research, capacity building, assisting organizations or individuals where appropriate, monitoring the country's economic performance and disseminating policy research results. The research function is specialised in the broad areas of Macroeconomic Forecasting and Planning, Microeconomics, International Trade and Finance Economics, Incomes, Welfare and Poverty Economics, and Public Sector Reforms and is headed by senior research fellows.[143]

Botswana Vaccine Institute (BVI) was originally established to insure Botswana's livestock industry freedom against Foot and Mouth Disease and to maintain exports of animal and animal products worldwide. Its mission is to support the livestock industry by manufacturing relevant vaccines and providing services of the highest quality through utilization of the best technology, skilled and dedicated employees to combat economically devastating livestock diseases. Through a network of partnerships, enhance adherence to sound manufacturing and environmentally friendly processes and remain sustainable.[144]

The company produces several types of vaccines. The Institute has exported vaccines to most of the SADC Countries, Eastern, Central and Western African Countries, some European Countries and some countries in Asia and the Middle East. In 1985, during the 53rd-General Meeting of the OIE, BVI was appointed the Regional Reference Laboratory for Foot and Mouth Disease (FMD) in Africa. BVI is also accredited to FAO (Food and Agriculture Organisation), and SADC (Southern African Development Community). [145]

National ICT research priorities include: eInfrastructures, technology-enhanced learning, sustainable agriculture and food security, entrepreneurship, cyber security, energy and water ecosystem, sustainable development and climate change and eHealth. The following universities and research centres in Botswana are conducting ICT-related initiatives: University of Botswana, Botswana International University of Science and Technology (BIUST), Limkokwing University of Creative Technology, Botho University, Botswana Accounting College and Botswana Technology Centre (BOTEC).[146]

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[142] IST Africa. (2016). Report on Innovation Spaces and Living Labs in IST-Africa Partner countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_InnovationSpaces_LL_v2_310116.pdf

[143] BIDPA. (2015). Annual Report 2013-2015. Retrieved May 12, 2017 from https://www.bidpa.bw/img_upload/pubdoc_76.pdf

[144] Botswana Vaccine Institute. (No Date). History. Retrieved May 12, 2017 from https://www.bvi.co.bw/content/id/61/History/

[145] Botswana Vaccine Institute. (No Date). History. Retrieved May 12, 2017 from https://www.bvi.co.bw/content/id/61/History/

[146] IST Africa. (2016). Report on Innovation Spaces and Living Labs in IST-Africa Partner countries. Retrieved March 10, 2017 from http://www.ist-africa.org/home/files/IST-Africa_InnovationSpaces_LL_v2_310116.pdf

The University of Botswana has developed a strategy to become a leading academic centre of excellence in Africa and the world. The aim of the research strategy is to enhance academic output. There are national and international drivers behind the need for the University of Botswana to transform its research performance. At national level, the draft Policy on Tertiary Education clearly requires the university to contribute more significantly to the new national research and innovation system, which is critical for the next stage of Botswana's development. There has been an increased research activity. Overall, the dominant research output type is the peer-reviewed journal article, followed by refereed conference papers and peer-reviewed book chapters, as shown in the table below.[147]

Table 1   Higher education knowledge outputs in Botswana[148]

Category of research output	2008	2009	2010
Peer-reviewed journal articles	306	338	347
Peer-reviewed books	22	23	28
Peer-reviewed book chapters	83	97	102
Patents	0	0	0
Other: refereed conference papers	131	98	178
Other: non-peer-reviewed journals	8	16	28

Sources: SARUA university questionnaires (2011)

Currently the University of Botswana and the Botswana College of Agriculture are the two main institutions that account for significant research output and graduate training. Much of the research takes place within faculties at the University of Botswana, and the university has set up a number of research centres and institutes that are aimed at increasing research output. These include the Okavango Research Institute, which specialises in natural resource management, and the University of Botswana Centre for the Study of HIV and AIDS. Other significant research centres are the University of Botswana International Tourism Research Centre and the Centre for Scientific Research, Indigenous Knowledge and Innovation, tasked with developing indigenous knowledge systems.[149]

4.3 Human Resource Development

Human resource development is a core focus of the National Development Plan 11 towards achieving the overall Vision 2036. A national Human Resource Development Strategy (NHRDS) was approved for implementation in 2009. The NHRDS forms a link towards achieving the goals and

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[147] Southern African Regional Universities Association. (2012): A profile of Higher Education in Southern Africa. Retrieved on April 19, 2017 from http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/SARUA%20Profiles%20of%20HE%20Vol%202.pdf

[148] Southern African Regional Universities Association. (2012): A profile of Higher Education in Southern Africa. Retrieved on April 19, 2017 from http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/SARUA%20Profiles%20of%20HE%20Vol%202.pdf

[149] Southern African Regional Universities Association. (2012): A profile of Higher Education in Southern Africa. Retrieved on April 19, 2017 from http://www.sarua.org/files/publications/SARUA%20leadership%20Dialogue%20Series/SARUA%20Profiles%20of%20HE%20Vol%202.pdf

targets through the diversification of the economy. The lead role for implementation of this strategy will be held by the MoESD with the support of the Human Resource Development Council (HRDC).[150]

According to the Tertiary Education Policy entitled 'Towards A Knowledge Society', the tertiary education is seen as a key component of Botswana's Research and Innovation system that will produce 'inventive, pioneering, high impact research and educate creative, talented and capable researchers for the successful transformation of Botswana into a Knowledge Society'.[151]

Research capacity development is a crucial challenge facing the University of Botswana. Growing the number and quality of our researchers is a strategic issue to achieve the vision of becoming a research-intensive university by 2021. The Research Capacity Development programme at the university involves a series of workshop with internal and external facilitators on a range of topics that may assist the researcher with either the attainment of their graduate degree, to begin their career as an independent researcher or to increase research output and externally funded grants. Career planning, mentorships, funding and skills development are core elements of the programme. The programme at the University of Botswana targets at early career researchers and graduate students.[152]

Botswana International University of Science and Technology (BIUST)'s newly launched strategic plan envisages that the university will be in par with the world's top universities by 2022. Key strategies include substantial investment on research and development, human resource capability and collaboration with the industry. BIUST currently has 1700 students in its ranks, with 242 of them pursuing postgraduate programmes. All academic staff at the university hold doctorate (PhD) qualifications.[153]

Botswana is currently spending a mere 0.2% of its GDP on research related activities.[154] In 2016, it was announced in parliament that P26 million will go towards building research capacity. The funds, which will be administered by Human Resource Development Council (HRDC), will be used to support higher education institutions wiling to carry out research in collaboration with the business sector to exploit new technologies and ideas. between training institutions and the industry in order to ensure that institutions provide training that is aligned to industry needs and standards. A further P100 million has been set aside be used to establish national research fund maintaining that the proposed fund will be used to finance research of relevance to the national priorities according to the requirements of the public and private sector.[155]

4.4 Key Actors and Players

Actor/Player	Role and Area of Development

[150] NRDC. (2009). National Human Resource Development Strategy 2009-2022. Retrieved March 19, 2017 from http://www.hrdc.org.bw/sites/default/files/NHRD STRATEGY-Final.pdf

[151] Ministry of Education and Skills Development. (2008). Towards a Knowledge Society – Tertiary Education Policy. Retrieved on April 19, 2017 from http://www.ub.bw/ip/documents/2008_PolicywhitepaperapprovedGovernment%20of%20Botswana.pdf

[152] University of Botswana. (No Date). Research Capacity Development. Retrieved April 19, 2017 from http://www.ub.bw/content/id/1958/pid/1800/ac/1/fac/8/Research-Capacity-Development/

[153] Weekend Post. (2016). BIUST launches ambitious strategy. Retrieved April 19, 2017 from http://www.weekendpost.co.bw/wp-news-details.php?nid=3027

[154] Weekend Post. (2016). BIUST launches ambitious strategy. Retrieved April 19, 2017 from http://www.weekendpost.co.bw/wp-news-details.php?nid=3027

[155] Weekend Post. (2016). P600 million for research and innovation. Accessed April 19, 2017 from http://www.weekendpost.co.bw/wp-news-details.php?nid=3141

Ministry of Infrastructure, Science and Technology (MIST)	Responsible for delivering quality building infrastructure, promoting socio-economic oriented technological research, and the safe application of nuclear technology, in partnership to enhance economic diversification and efficiency
Department of Research Science and Technology (DRST)	Provide leadership in science and technology in through the provision of an enabling policy and legislation environment and coordination of science and technology activities
Department of Building and Engineering Services (DBES)	Responsible for building and development projects and respective and required infrastructure, engineering services together with the maintenance function
Botswana Institute for Technology Research and Innovation (BITRI)	A research and technology parastatal organization, with the core function of aligning the RST products and services in support of the Vision 2036 goals and the National Development Plans
Botswana Innovation Hub	Offers a global standard of telecommunications infrastructure with paramount connectivity, business services and business development services to technology-driven and knowledge intensive businesses
Centre for Applied Research	Carry out high-quality consultancy and research; build capacity in natural resource management and sustainable development planning; contribute to poverty reduction and sustainable development and growth
University of Botswana	Established in 1982 as the first institution of higher education in Botswana; state-owned university which offers academic and professional training, and is a key institution for research in the country
Botswana Institute for Development Policy Analysis (BIDPA)	BIDPA's mandate is to development policy analysis and capacity building. Its aim is to promote policy analysis through research, capacity building, assisting organizations or individuals where appropriate, monitoring the country's economic performance and disseminating policy research results
Botswana Vaccine Institute (BVI)	Its mission is to support the livestock industry by manufacturing relevant vaccines and providing services of the highest quality through utilization of the best technology, skilled and dedicated employees to combat economically devastating livestock diseases

4.5 Challenges facing the STI sector

As discussed above, Botswana's economic success until now has principally resulted from the exploitation of mineral resources, coupled with prudent economic management. But the reality is that such mineral resources (most notably diamonds) are not unlimited. For Botswana to continue to grow and prosper the country needs to diversify its economic base and especially strengthen its human resources. Vision 2036 recognizes these realities and specifically that Botswana does not at present have a strong tradition of technical research and development that can be used as a basis for developing 'home grown' technology. Clearly in the early stages most of the technology will need to be adapted from elsewhere. However, even the transfer and adaptation of technology to local conditions will require an expansion in the capacity for research and development within Botswana. Botswana has an established defined national RSTI policy which was adopted in 2012. As part of the new RSTI policy, the research arena is expected to be coordinated more efficiently and effectively and also to be focused on certain specific areas of importance.

There are various challenges faced by the STI sector in Botswana. Adequate funding is a major challenge for research initiatives and projects. A skills shortage is also a factor that hinders the

development of STI in Botswana. This is attributed to the lack of coordination between tertiary institutions and STI industry players to assess the market demands for skills and research. Another factor challenging the status of Botswana as a KS is the low participation of women in science, technology, engineering and mathematics.[156]

There is a fundamental weakness in the country's research and innovation system, with regard to the fact that tertiary level research has almost exclusively been centred on the only two public university (University of Botswana and Botswana International University of Science and Technology) with very little capacity or opportunity for research existing in the rest of the system. While the current primary focus is on technology adoption and developing applications, there is a strong policy focus on further strengthening the research capacity within the country, and especially in facilitating the continued development of post-graduate programmes and involvement in cross-border research.

Whilst the policy framework exists, efficient implementation strategies are lacking. The involvement from the private sector in the STI arena is minimal because of lack of incentives which is a constraint towards establishing collaborative efforts between the private and public sectors. The country is handicapped by its comparatively small population, which places an effective cap on the quantity and depth of knowledge expertise available. The general effect is a lack of innovative culture to promote a sustaining interest and development in the STI pillar of the KS in Botswana. Additionally, low levels of tertiary education identified in the Botswana context and a resource based economy may translate into low per capita earnings and a subsequent lower demand for innovative products.

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[156] Weekend Post. (2016). P600 million for research and innovation. Accessed April 19, 2017 from http://www.weekendpost.co.bw/wp-news-details.php?nid=3141

5 Conclusion

It can be concluded and commended that Botswana's policies strategies and future plans are well aligned to the Knowledge Society developmental goals as articulated in Vision 2036. With the established policies, platforms, legislative measures and strategies held, Botswana is at a unique stage of advancement towards a Knowledge Society. However, progress in the implementation of policies and frameworks has been hindered by infrastructural issues, human capital deficits and lack of adequate funding. The discrepancy between an established and well documented policy structure and levels of implementation is not as large as may be typical in other African countries.

There are many contradictions in Botswana's development. While the country ranks very highly in the Africa region with regard to its ICT platform, the low penetration and usage of internet does come as a surprise. While Botswana remains a resource-based economy, the development of strong ICT and Educational platforms will not factor in development priorities. Botswana's economic success to date has not been dependent on technological advancement; however, the nation seeks to propel development towards a Knowledge Society which almost sets or raises expectations towards rapid ICT development. It also comes as a surprise that with the further liberalisation of the communications market and removing many regulatory impediments, the internet access in Botswana is still very low. The huge investments in broadband infrastructure have not directly translated to cheaper internet access. The introduction of the wholesale capacity provider (BOFINET) has not helped the ordinary citizen as the operators seem to have not taken advantage of focusing on the retail or last mile, but have rather opted to make profits out of the current scenario.

Ministries handling the KS portfolios of ICT, Education and STI lack, to a certain extent, the cohesiveness and inter-linkage and progress on different agendas independent of each other. The Education sector evidently is prepared with regard to the training of teachers, introducing computers and internet connectivity across all the schools, however, are held back to a large extent due to lack of internet connectivity and electricity. A similar pace of advancement and interlinked development agendas across the ministries handling the ICT and Education portfolios would be desirable. Tertiary education has progressed at a slower pace compared to primary and secondary education in Botswana which has led to the mismatch of demand and supply of skills desired by the industry players. This mismatch is also a primary reason for the high levels of unemployment with a large percentage of the adult population being unemployable due to lack of skills demanded and required by the various economic sectors other than mining, quarrying and agriculture.

Another factor challenging the status of Botswana as a KS, and achieving the SDG of gender equality, is the low participation of women in science, technology, engineering and mathematics.[157]

It can be concluded that the STI platform may have taken a lower priority in the last decade since economically the country has been flourishing since independence; however, Botswana did suffer during the Global Financial Crisis with a decrease in demand for its core export (diamonds). Therefore, the over-reliance on the mineral resources has placed the STI pillar of the KS at a very low priority and is now being sought and developed in order to diversify its economic portfolio.

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[157] Weekend Post. (2016). P600 million for research and innovation. Accessed April 19, 2017 from http://www.weekendpost.co.bw/wp-news-details.php?nid=3141

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About GESCI

The Global e-Schools and Communities Initiative (GESCI) is an international non-profit organisation founded on the recommendation of the ***United Nations Task Force on Information Communication Technology*** (ICT). GESCI was established in 2003 at the first World Summit on the Information Society.

The United Nations ICT Task Force identified **education as an area in critical need of development**, and one where **ICT has the potential to make a positive impact**. Initially GESCI was headquartered in Dublin, Ireland, and in 2011 moved its headquarters to Nairobi, Kenya.

GESCI's mandate is to assist governments in the socio-economic development of their countries through the widespread integration of technology for inclusive and sustainable knowledge society development.

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