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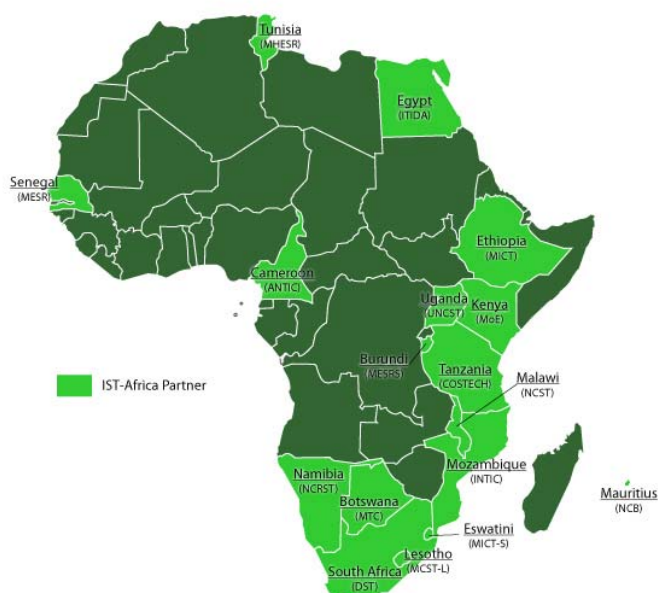
1. EXECUTIVE SUMMARY

1.1 Context and Objectives

The IST-Africa Initiative¹ is actively supporting Research and Innovation cooperation between Africa and Europe. It can be challenging for both European and African researchers to access the most up to date information in relation to the current situation in a specific African country with which they may wish to collaborate. There is also a significant challenge of data fragmentation at national level that can also impact on cooperation between local stakeholders.

As a result the IST-Africa Consortium have undertaken a longitudinal study across the 17 participating African countries in North Africa (Egypt, Tunisia), West Africa (Senegal), East Africa (Burundi, Ethiopia, Kenya, Tanzania, Uganda), Central Africa (Cameroon) and Southern Africa (Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland) since 2009 to provide regular updates to this comprehensive report that showcases achievements and current status in relation to the ICT research environment, national research priorities and research and innovation capacity. An ongoing mapping of existing and emerging Innovation Spaces supporting technology-related community development as well as entrepreneurship has also been undertaken across the IST-Africa Partner Countries.

This study leverages previous knowledge and provides an updated overview of the current state of national ICT and Innovation related policy, infrastructure, initiatives and research priorities. It highlights research priorities that are most relevant in the context of the ICT-39-2017 Call of Horizon 2020 (specifically designed to focus on collaborative research and innovation projects addressing the needs of resource constrained end-user communities, particularly in Africa) and future African focused Calls (Diagrams 1 and 2, Table 2 and 3), a mapping of research priorities across Horizon 2020 (H2020) thematic areas and national partners (Tables 4 and 5, Diagrams 3 and 4) as well as a mapping of Innovation Spaces (Diagram 9). This assists in a better understanding of initiatives in key thematic areas that have been supported, the current environment within which research and innovation activities (including pilots) need to be undertaken and showcases national partners with relevant research and innovation expertise to facilitate consortia building. It also provides the



¹ www.IST-Africa.org/

participating Ministries and National Councils with the opportunity to raise awareness among both public and private sector research community stakeholders of current activities in other African Member States.

The IST-Africa Partner Countries made considerable progress in terms of research project participation during FP7. IST-Africa continues to actively encourage participation by African institutions in both relevant general and African specific Calls under Horizon 2020. As part of the strategy to increase African participation, IST-Africa provided evidence to the European Commission to justify and secure c.€26 million for African-focused research cooperation under the LEIT Work Programme of Horizon 2020 (ICT-39-2015 Research and Innovation Actions; ICT-39-2017 Innovation Actions). These two dedicated calls were very successful, attracting a high level of submissions and a high proportion of proposals eligible for funding (Boxes 3 - 10) . This study highlights areas for research cooperation under Horizon 2020 as well as the specific African-centric calls.

As at September 2018 there are over 625 participations from 364 organisations across 35² African Member States countries involved in 279 Horizon 2020 projects, bringing research funding in excess of €91.9 million into African research centres and universities since 2014 (Diagrams 7 and 8). Up to September 2018, over seventy six percent of all participating African organisations in funded Horizon 2020 projects are from IST-Africa partner countries securing grant funding of over €69.9 million euro.

It is important that national ICT research and innovation priorities are aligned with national strategic priorities and available expertise. This requires a regular consultation with the national universities and other Higher Education Institutions to determine research and innovation capacity and identify how stakeholders across the public, private and the education and research sectors can collaborate through research and innovation to implement solutions leveraging ICT that address both national and regional societal challenges as well as supporting socio-economic development.

The following sections outline the Methodology used, and present a summary of the current ICT enabling Environment, ICT-related Initiatives and Research Capacity in the targeted countries; National Research Priorities, Priority areas for collaboration in the context of the future ICT-39 Calls in H2020, a mapping of research priorities to H2020 themes, summary of participation under FP7 and Horizon 2020 and a mapping of Innovation Spaces. Each country chapter then provides more detail.

1.2 Methodology

This study builds on a previous study and body of knowledge collected by IST-Africa Partners during 2009 – 2015 and reflects the current situation as at December 2018.

² Algeria; Angola; Benin; Botswana; Burkina Faso; Burundi; Cabo Verde; Cameroon; Democratic Republic of the Congo; Egypt; Ethiopia; Gabon; Gambia; Ghana; Kenya; Lesotho; Liberia; Libyan Arab Jamahiriya; Madagascar; Malawi; Mali; Mauritius; Morocco; Mozambique; Namibia; Nigeria; Rwanda; Senegal; South Africa; Swaziland; Tanzania; Togo; Tunisia; Uganda; Zambia

The research for this report was undertaken in three stages: October to December 2016, August to October 2017 and then updated during June to December 2018 to reflect more recent developments. The methodology leveraged desk research, qualitative data collection complimented by interviews with key stakeholders in Botswana, Burundi, Cameroon, Egypt, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Senegal, South Africa, Swaziland, Tanzania, Tunisia and Uganda, supplemented by follow up e-mails and telephone calls where appropriate.

IST-Africa partners undertook a consultation with national stakeholders from October - December 2016 in relation to priority areas of most relevance in the context of the Horizon 2020 ICT-39-2017 Call to contribute to the mapping provided, which has been actively circulated during the preparation phase for proposals targeting the ICT-39-2017 Call.

From October - December 2016 the IST-Africa Partners organised Horizon 2020 Training Workshops in **Botswana** (17 November 2016, hosted by MTC), **Cameroon** (09 December 2016, hosted by ANTIC), **Ethiopia** (21 November, hosted by MCIT), **Kenya** (10 November, hosted by MoEST), **Lesotho** (02 November 2016, hosted by MCST), **Mauritius** (14 December 2016, hosted by NCB), **Malawi** (28 November 2016, hosted by NCST), **Namibia** (26 October 2016, hosted by NCRST), **Swaziland** (02 November 2016, hosted by MICT), **Tanzania** (14 November 2016, hosted by COSTECH) and **Uganda** (20 November, hosted by UNCST) primarily focused on collaboration opportunities under the Horizon 2020 ICT-39-2017 Call. Additional information on research priorities and research and innovation capacity was collected during these workshops.

1.3 ICT Enabling Environment and ICT Initiatives

This section provides an overview of available eInfrastructure, policy environment and types of thematic ICT Initiatives ongoing in IST-Africa Partner Countries grouped by region of Africa. It is clear that the available eInfrastructure has dramatically improved over the past ten years with more extensive access to fibre optic networks, establishment of national Internet Exchange points and access to additional submarine cable connections. There is also a noticeable increase in the number of NRENs (National Education and Research Networks). Table 1 provides an overview of existing and planned eInfrastructure from the perspective of access to submarine cables, national ICT Backbone, Internet Exchange Points, Public Key Infrastructure (PKI), National Education and Research Networks (NRENs), participation in AfricaConnect, tele-centres/community centres and status of Universal Access Funds in the IST-Africa Partner Countries.

North, Central and West Africa

*Significant investment in eSkills
29 Public Universities
Good eInfrastructure
ICT initiatives focused on
Learning, Health, Government,
Content Creation*

Egypt has a vibrant research community and considerable experience of participation in collaborative research. The ecosystem currently includes 29 public Universities, 43 private Universities and more than 400 private Higher Education Institutions. Of these 66 have engineering or ICT departments. The Egyptian Government has significantly invested in capacity

building, digital literacy and certification of skills. The most recent published ICT Policy (2013 – 2017) is focused on achieving sustainable socio-economic development in key ICT sectors: Digital Identity; Egypt Digital Hub; Basic Infrastructure (Broadband, Cloud Computing, Submarine Cables); Cyber Security & eSignature; Information Infrastructure & Digital Content; Electronics Design & Manufacturing; Legislative and Policies Framework. The Sustainable Development Strategy (SDS): Egypt Vision provides a roadmap to maximize the potential contribution of ICT to the economic growth of the country. There is good eInfrastructure with links to three submarine cables, a national backbone and national Internet Exchange Point (IXP) in place. ICT Initiatives are focused on eLearning, eHealth, eGovernment, eContent, Community Integration and ICT for people with disabilities; Broadband Access Network and Internet of Things.

Strong Research base

13 Public Universities

Good eInfrastructure

ICT initiatives focused on Digital Economy, Education, CyberSecurity & eGovernment

Tunisia has an active research community and strong research base with 13 public Universities including a virtual University, over 208 public Higher Education Institutions, over 38 public research centers and more than 72 private Higher Education Institutions, of which 30 have departments of engineering or ICT. There is a good policy Framework in place and good

eInfrastructure with links to three submarine cables, a National backbone based on fibre optic cables and a National IXP. Good progress has been made with implementation of "Tunisie Digitale 2020" by the Ministry of Digital Economy, focused on promoting e-transformation and boosting the digital economy. This program has made an important contribution to Tunisia's objective of ICT supporting socio-economic development. Current ICT Initiatives are focused on eGovernment Services, eHealth and eInfrastructure for Education, Research and Innovation.

Good experience in

Collaborative Research

8 Public Universities

Improving eInfrastructure

ICT initiatives focused on eGovernment, Education, National PKI, National ID

Cameroon has a good research base and experience of collaborative research with 8 public Universities, over 180 private institutions for Higher Education and several laboratories. There is a good Policy Framework in place (ICT Policy 2007, Electronic Communications Law, CyberSecurity Law and Electronic Commerce Law). The Cameroon Digital Economy Strategy was adopted in late 2016. eInfrastructure is gradually improving with

a national backbone of over 6,000 km of fibre optic cable, a fibre optic loop in Douala and Yaounde and a National Internet eXchange point (IXP) set up in Douala and Yaounde. There are 150 operational tele-centres, with a further 30 being put into service and 16 under construction. Current ICT Initiatives are primarily focused on eGovernment Services (including Legal and Regulatory Framework), National PKI, eInfrastructure and ICT Programmes in Primary and Secondary Schools.

Good Research base
8 Public Universities
Improving eInfrastructure
ICT initiatives focused on
eGovernment, Education,
eInfrastructures, Digital Divide

Senegal has a good research base with eight public Universities, 7 private Universities, 6 public Higher Education Institutions and 141 private Higher Education Institutions. There is a good Policy Framework in place to address Electronic Transactions, Cybercrime and Data Protection. A National Strategy for developing ICT was defined in 2000 with

the State Information Technology Agency (ADIE) created in 2004 and laws focused on eTransactions, Cybercrime Privacy enacted in 2008. In terms of eInfrastructure there are links to three submarine cables, all regions are connected via fibre optic, the national backbone is under construction and the SenIX Internet Exchange Point was launched in August 2017. SnREN (National Research and Education Network) is supporting HEIs. ICT Initiatives focus on eGovernment, eInfrastructure, Research, Entrepreneurship and eEducation

East Africa

7 Public Universities
Improving eInfrastructure
ICT initiatives focused on
eGovernment, Education,
eInfrastructures

Burundi is slowly building up its institutions and infrastructure following twelve years of crisis up to 2005. There are currently 7 public institutions of Higher Education and 42 private institutions of Higher Education. The National ICT Policy was revised and adopted in 2011 and the National Policy for Science, Technology

and Innovation (STI) launched in 2014. While a decree establishing the National Commission for Science, Technology and Innovation was signed in July 2014, there is currently no dedicated mechanism to fund national research and innovation. 1,254 km of fibre-optic cable has been laid and 50 public institutions are now connected through the Government Communication system. Public institutions are being connected through the Government Communication systems project. The Burundi Education and Research Network (BERNET) has now connected 15 institutions through an agreement with the Burundi Backbone System (BBS) Company. Current ICT initiatives are focused on eInfrastructure and eGovernment.

Good research base
45 Public Universities
Improving eInfrastructure
ICT initiatives focused on
eGovernment, eInfrastructures,
PKI, Education,
entrepreneurship

Ethiopia has a good research base and experience of collaborative research with 45 public Universities and 45 private Higher Education Institutions. There is a good Policy Framework in place with the ICT Policy and Strategy (revised in 2017), National Science, Technology and Innovation (STI) Policy (2012) and ICTs in Education Implementation Strategy and Action Plan (2010). eInfrastructure is rapidly improving with 14,000 kms of

optic fibre cable radiating from central Ethiopia across the country to connect all cities. MCIT established 300 Community Information Centres and 12 community radio stations across the country to provide information on new ICT technology transfer and implementations, healthcare, agricultural information and education issues. ICT Initiatives are primarily focused on eGovernment

and Public Key Infrastructure (PKI), eInfrastructure including EthERNet (Ethiopian Education and Research Network), Entrepreneurship and eEducation

Good experience in Collaborative Research
31 Public Universities
Good eInfrastructure
ICT initiatives focused on eGovernment, Education, Local Content, Security

Kenya has a vibrant research community and strong experience of collaborative research with 31 fully chartered Public Universities, 6 public University Constituent Colleges, 6 public research institutes, 18 accredited private Universities, 14 private Universities with letter of interim authority and 5 private University Colleges. There is a good Policy Framework in place including CyberSecurity Strategy (2014), eGovernment Strategy,

Kenya ICT National Master Plan 2017, Kenya Science, Technology and Innovation (STI) Policy 2012, STI Medium Term Plan 2018 and Vision 2030. There is good eInfrastructure with a comprehensive national fibre optic infrastructure (over 6,000km) and links to four submarine cables. KENET is the 2nd largest NREN in Africa now supporting 240 campuses and managing the largest IP network in Kenya. ICT Initiatives are focused on eInfrastructure, eEducation & eSkills, Digital Inclusion, Business Process Outsourcing, Local Content, Information Security and eGovernment.

Good research capacity
11 Public Universities
Improving eInfrastructure
ICT initiatives focused on eInfrastructure, Innovation, Education, eHealth

Tanzania has good research capacity with 11 Public Universities, 17 private universities and 26 private institutions of Higher Education. The ICT Policy was revised and adopted in 2016. eInfrastructure has dramatically improved with the fibre-optic network, investment in local Internet Exchange Points, migration to IPv6 and construction of the National ICT Backbone (NICTBB). Tanzania Education Research

Network (TERNET) has connected 18 Institutions to Network Operations Centre (NoC) at COSTECH. ICT Initiatives are primarily focused on eInfrastructure, eEducation, eHealth, Information Society & Entrepreneurship. The Ministry of Communication, Science and Technology was renamed Ministry of Works, Communication and Transport and a Ministry of Education, Science and Technology established in 2015.

Good experience of Collaborative Research
8 Public Universities
Improving eInfrastructure
ICT initiatives focused on eGovernment, eInfrastructure, Education, eHealth

Uganda has a strong research base and good experience of collaborative research with 8 Public Universities, 33 Private Universities, 40 public Tertiary Institutions and 51 private Tertiary Institutions. There is an Innovation friendly Policy Framework, which has actively supported growth in the ICT sector including Science Technology and Innovation Policy (2009), ICT Policy (revised in 2012 and adopted in FY2014/2015), Rural Communications Development Policy and eGovernment

Strategy (2011). eInfrastructure has improved with a national backbone of over 5,000 km of fibre optic cable, National Data Transmission Backbone Infrastructure (NBI) and Electronic Government Infrastructure (EGI) and links to three submarine cables. Current ICT Initiatives are primarily focused on eInfrastructure, eGovernment, Technology-enhanced Learning, eHealth, eCommerce and ICT

for Rural Development and Entrepreneurship. The National ICT Initiatives Support Programme (NIISP) aims to facilitate growth and development of the software applications and innovations industry.

Southern Africa

4 Public Universities

Good eInfrastructure

ICT initiatives focused on eGovernment, Digital Divide, Innovation, Cyber Security

Botswana has 4 public Universities and 4 private Universities. There are 40 Higher Education Institutes including DVET, of which 20 are public HEIs. There is a good Policy Framework including the revised Research, Science, Technology and Innovation Policy (2012) and Electronic Communications and Transactions Bill (2013). The Botswana Institute of Technology Research and Innovation (BITRI) was established in 2012 to conduct needs-based research and development in the fields of technology and natural resources and materials, and the Botswana Innovation Hub which promotes technology adoption and entrepreneurship. There is relatively good eInfrastructure with fibre-optic networks and a National Backbone. ICT Initiatives primarily focus on Digital Divide, eGovernment, Cyber Security, Innovation and Entrepreneurship.

1 Public University

Increased focus on research

Improving eInfrastructure

ICT initiatives focused on Education, eHealth, eGovernment, Cyber Security

Lesotho is gradually increasing the focus on research with one public university (National University of Lesotho), Lerotholi Polytechnic, Lesotho College of Education, National Health Training Centre and a private university (Limkokwing University of Creative Technology). There is a good Policy Framework including the ICT Policy (2005), Universal Access Fund (2009), Science Technology and Innovation Policy (2010), Communications Act (2012), Electronic Commerce and Transaction Bill (2013), Lesotho National Broadband Policy (draft, 2014), Computer Crime and Cybercrime Bill (draft, 2015) and National Strategic Development Plan (2013 – 2017). The mountainous terrain presents challenges for eInfrastructure, which is improving gradually. There is now a national backbone (mix of copper cables, fibre optic cables and satellite) connecting all districts, with links to two submarine cables, operational IXP and 17 completed GSM network infrastructure projects subsidised by the Universal Access Fund. The mobile network is gradually expanding to unserved and underserved areas and access to broadband (3G and LTE) is steadily increasing in the education sector. Current ICT Initiatives are primarily focused on eLearning, eHealth, eGovernment, Cyber Security and eInfrastructure.

4 Public Universities

Increased focus on research

Improving eInfrastructure

ICT initiatives focused on Education, eHealth, eGovernment, Digital Repositories

Malawi has a good research base and experience of collaborative research with 4 Public Universities (University of Malawi, Mzuzu University, Lilongwe University of Agriculture and Natural Resources and Malawi University of Science and Technology), 7 public Polytechnics and specialised Colleges and 4 private Colleges. There is a good Policy Framework including the ICT Policy (revised 2013), Universal

Access (2013), eLegislation and Cybersecurity Act (2016), National ICT Master Plan for 2014 – 2031, Vision 2020 and Malawi Growth and Development Strategies (2011 - 2016). eInfrastructure is gradually improving with an expanded fibre infrastructure, IXP and Last Mile Connectivity & Universal Access projects. Current ICT Initiatives are primarily focused on eGovernment, eInfrastructures, eHealth, Technology-enhanced Learning and Digital Repositories. A Ministry of ICT was established in 2016 to take responsibility for policy and implementation across government.

Good research base

7 Public Universities

Good eInfrastructure

ICT initiatives focused on Education, eGovernment, Cyber Security, Entrepreneurship, Green IT

Mauritius has a good research base with 7 Public Universities (UoM, UTM, UDM, Open University, Fashion and Design Institute, MGI, MIH) and 5 private Universities (Charles Telfair, Middlesex, Amity Institute of Higher Education, C-DAC School of Advanced Computing, Whitefield Business School). There is a good

Policy Framework including the National ICT Strategic Plan (NICTSP), National Broadband Policy 2012 - 2020, eGovernment Strategy 2013 - 2017, National Cyber Security Strategy and Action Plan (2014 - 2019), National Open Data Policy (2017) and Digital Government Transformation Strategy (2018 - 2022). In 2015, the Ministry of Technology, Communication and Innovation (MTCI) replaced the Ministry of Information Technology and Communication (MICT) to foster innovation and the ICT industry – one of the pillars of the economy. eInfrastructure is well developed with an IXP, National PKI, links to three submarine cables and 350 locations with WiFi internet access. Current ICT Initiatives are primarily focused on eEducation, Digital Divide, eGovernment, Cyber Security, Entrepreneurship and Green IT.

4 Public Universities

Improving eInfrastructure

ICT initiatives focused on eGovernment, eHealth, eInfrastructure, Digital Content, Digital Divide

Mozambique has research capacity and a track record in collaborative research with 4 Public Universities, 14 public Higher Education Institutions, 11 private Universities and 20 private Higher Education Institutions. A further twenty-two institutions (15 public, 7 private) are dedicated to research activities. There is a good Policy Framework. The ICT Policy

(2000), ICT Policy Implementation Strategy (2002) and eGovernment Strategy documents were revised from 2015 and Information Society Policy, Information Society Strategic Plan and Information Society Operational Plan have been submitted to Government for approval. Following approval of the Electronic Transactions Law in 2018, INTIC became the national ICT Regulator, with INAGE established to implement eGovernment services. eInfrastructure is gradually improving with a National Broadband Backbone providing optical fibre connection to all 11 provincial capitals, provincial Digital Resource Centres, an IXP in Maputo, the Mozambique Research and Education Network and links to two submarine cables. Current ICT Initiatives are primarily focused on eGovernment, eHealth, eInfrastructure and CyberSecurity.

2 Public Universities

Increased focus on research

Improving eInfrastructure

ICT initiatives focused on Education, eHealth, eGovernment

Namibia is gradually increasing the focus on research with 2 Public Higher Education Institutions (University of Namibia, Namibia University of Science and Technology) and one private University (International University of Management). There is a good Policy Framework in

place including Vision 2030; National Development Plan 5, ICT Policy (2009), Communications Act (2009), eGovernment Policy (2005) and ICT in Education Policy (2005). The following policy and legislative frameworks are being prepared: Electronic Transactions and Cybercrime bill, Broadband (BB) Policy, Universal Access Regulations and the Universal Access Fund, Framework for Software development and cost sharing, Computer Incident Response Team (CIRT), E-waste management policy. eInfrastructure is improving with fibre optic cables connections to all major towns, investment in a nationwide terrestrial fibre backbone infrastructure, Government network backbone infrastructure (increased to 600Mbps) IXP, Xnet (NREN) and links to two submarine cables. Current ICT Initiatives are primarily focused on eEducation, eHealth and eGovernment.

Well developed research community

Well developed national ICT Policy

26 Public Universities

Good eInfrastructure

ICT initiatives focused on eInfrastructure, Education, eHealth and eAgriculture

South Africa has a vibrant, well-developed research community and a good track record in collaborative research with international partners. There are 26 state-funded tertiary institutions (Universities & Universities of Technology) and 100 private institutions of Higher Education. There is a good Policy Framework including the National Integrated ICT Policy White Paper (2016), Broadband Policy (2013), ICT RDI Implementation

Roadmap (2013), National CyberSecurity Policy Framework (2012), eGovernment Strategy and Roadmap, National eStrategy, and the South African Research Infrastructure Roadmap. eInfrastructure for research is well developed with TENET (Tertiary Education and Research Network of South Africa) and the Council for Scientific and Industrial Research (CSIR) sharing the responsibility of building and operating the South African National Research Network ("SANReN"), which comprises of a national backbone, several metropolitan rings, and some dedicated long-haul circuits to connect specific research installations. SANReN provides Internet and related services to 227 sites including university campuses and state research institutions. SANReN, the Centre for High Performance Computing (CHPC) and the Data Intensive Research Initiative of South Africa (DIRISA) are three pillars of the National Integrated Cyber Infrastructure System (NICIS), which promotes scientific and industrial development through the provision of high-performance computing capability, high-speed network capacity and a national research data infrastructure. ICT Initiatives focus on eInfrastructure, Digital Access and eSkills.

1 Public University

Improving eInfrastructure

ICT initiatives focused on eGovernment, eInfrastructures

Eswatini is gradually increasing the focus on research with one public university and four private Higher Education institutions. There is a good policy infrastructure focused on the adoption of ICT to support socio-economic development

(National Information and Communication Infrastructure Policy 2006, Science Technology and Innovation Policy 2012 and Swaziland Communications Commission Act 2013). eInfrastructure is gradually improving with a fibre optic backbone network, IXP established in 2014, connection to two submarine cables through Mozambique and South Africa and free internet access in schools and hospitals through ITU. ICT Initiatives are primarily focused on eGovernment and the Science and Technology Park.

eInfrastructure Projects

A number of eInfrastructure projects have been funded by the European Commission through European Development Funds, African Development Bank and World Bank. Regional infrastructure network projects supported by the European Commission and EU Member States include AfricaConnect, AfricaConnect 2 (Box 1) and AXIS (Box 2).

Box 1: Africa Connect (EDF10) & Africa Connect 2 (EDF 11)

Africa Connect was co-funded from 2011 - 2015 under European Development Funds 10 (EDF10), with a budget of €14.5 million based on 80% funding through DG DEVCO and 20% of funds provided by African partners on a cost-sharing model. AfricaConnect 2 was co-funded under EDF11 from late 2015 to 2019, with a budget of €26.6 million based on 80% cofunded by DG DEVCO.

The AfricaConnect projects, both the first one as the second (AfricaConnect2), have been set up with the intention to establish high-capacity internet networks for research and education in the African continent and to strengthen the link with Europe to allow for global collaborations. Through these projects, the project also aims to support the fulfilment of the region's MDGs (Millennium Development Goals) and SDGs (Sustainable Development Goals), open up research activities in the region and build co-operation with the rest of the world, reduce poverty, brain drain and the digital divide, all through the creation and use of National Research and Education Networks (NRENs).

The first project, has established a high-capacity Internet network for research and education in Southern and Eastern Africa providing the region with a gateway to global research collaboration. AfricaConnect, which lasted four years, began in May 2011, and consisted of two phases, the first of which was for the planning and procurement of the network, and the second its operation.

Achievements include:

April 2012: international link seamlessly connecting African radio astronomers to Europe through the UbuntuNet network and GÉANT

July 2012: Zambian and South African researchers to connect through the first UbuntuNet cross-border link

November 2012: official launch of the UbuntuNet network

June 2013: NRENs and members in Sub-saharan Africa to receive training from Oregon based NSRC (Network Startup Resource Center) to narrow the global digital divide

July 2014: UbuntuNet being commissioned in Southern and Eastern Africa with Points of Presence (PoPs) in Mtunzini, Maputo, Dar es salaam, Nairobi, Kampala and Kigali connecting to UbuntuNet Alliance's PoP in London, as well as a transcontinental link between Nairobi and UbuntuNet Alliance's PoP in Amsterdam. Serving the following 6 NRENs: TENET (South Africa), MoRENet (Mozambique), TERNET (Tanzania), KENET (Kenya), RENU (Uganda) and RwEdNet (Rwanda). This also formed the backbone on which the network serves the entire UbuntuNet alliance region.

October 2014: Joining forces with the medical community to combat tropical diseases: colleagues around the world led a helping hand to formulate the programme for a special Ebola Symposium at the UbuntuNet Alliance annual conference

Box 1 cont.: AfricaConnect 2 (EDF 11)

AfricaConnect 2

After the success of AfricaConnect, a second project continued the aim to support the development, consolidation and use of high-capacity NRENs across Africa. AfricaConnect2 extends the scope of its predecessor to a pan-African level by connecting North, Western and Central Africa and supporting these regions through a modular approach adjusted to specificities of the African sub-regions. The project comprises three geographical areas and involved their respective regional networking organisations: ASREN in North Africa, WACREN in West and Central Africa, UbuntuNet Alliance in Eastern and Southern Africa.

AfricaConnect 2 Achievements include:

February 2016: Lebanon joining the global research and education networking community with a link from the American University of Beirut (AUB) to the ASREN PoP in London

March 2016: Ugandan NREN RENU providing high capacity and affordable internet connectivity for Ugandan, South African and Norwegian universities to collaborate to build capacity in the Ugandan media sector by strengthening research and training

AfricaConnect 2 Achievements (cont.) include:

April 2016: major boost for EU-Algerian science collaboration since the connectivity upgrade from 622 Mbps to 2.5 Gbps by ASREN and GÉANT

October 2016: GÉANT, the UbuntuNet Alliance, and Indiana University co-lead \$3.25M grant to improve research collaborations between Europe, Africa, and the US. Improved intercontinental networks will support critical research in foodsecurity, environment preservation, and HIV treatment

June 2016: high-speed internet access enables researchers in Zambia to rapidly acquire large data sets and gain an accurate understanding of physical, chemical and biological soil processes and their roles in delivering ecosystem services; in addition, faster analysis results allow them to *monitor soil degradation and provide input to sustainable land management policies*

October 2016: NORDUNET's Knowledge Exchange Fellowship programme including participants from Ghana, Lebanon and Zambia to exchange experience and knowledge with Nordic R&E networks, and other emerging networks around the world, shows the importance of physical and human connections in the R&E community

January 2017: SomaliREN using the NREN to address brain drain

November 2017: from optimising administrative processes on campus to job creation: a story of the students from Kyambogo University in Uganda benefitting from the NREN

February 2018: Kenya Finland partnership boosting access to geoinformatics education and training to aid sustainable development. Kenyan NREN KENET upgraded internet speeds for the university which allowed support of the partnership by the existence of an increased bandwidth of up to 1 GB

February 2018: Women in WACREN event, inviting trainers from the global R&E community, to empower women in Science, Technology, Engineering and Mathematics (STEM). The February workshop evolved around learning Python, as the main focus of the software development workshop

March 2018: official launch of WACREN network with a link from Lagos to London, where it interconnects with the GÉANT network and from there to over 100 countries worldwide with an additional link from Lagos to Accra

May 2018: AfricaConnect2 and Egyptian NREN ENSTINET enable scientists at the National Authority for Remote Sensing and Space Sciences (NARSS) to monitor and predict sandstorms, assisting Egyptian authorities in issuing timely alerts to asthma sufferers

Box 1 cont: AfricaConnect 2 (EDF11)

May 2018: Tanzanian NREN TERNET supplying 10 Mbps of fast, dedicated and reliable bandwidth to member university Aga Khan University providing support to the university's IT infrastructure, allowing teachers and students to virtually traverse across universities through applications such as Zoom, Skype and Moodle

June 2018: Morocco to re-connect international R&E community through AfricaConnect2

July 2018: Somalia connected to the UbuntuNet network

July 2018: WACREN joining the global R&E networking infrastructure by signing the Open and Interconnection Agreements with GÉANT

September 2018: ASREN and GÉANT signed an interconnection agreement to upgrade the existing link of ASREN to the GÉANT network at a capacity of 10 Gbps through the London Open Exchange

October 2018: internships showing the transformational effects NREs can have as an enabler of learning and knowledge in emerging economies in Nigeria

November 2018: Tunisia to re-connect international R&E community through AfricaConnect2

Ongoing Work

AfricaConnect2 is currently focusing on getting countries connected, especially in the WACREN region where a link has been officially launched since March 2018 from Lagos to London. NREs in Western and Central Africa can, just as has shown in the UbuntuNet region, benefit from this backbone to get their members connected regionally as well as to the global R&E community. A great effort being committed to support the NREs and regional RENs with communications and visibility, ranging from having created an 'Africa Comms' channel on Slack to continuously engaging digitally with the community. Preparations are in place towards an AfricaConnect3 project starting in the second half of 2019.

Box 2: African Internet Exchange System (AXIS)

The African Internet Exchange System (AXIS) project aims to support the establishment of a continental African Internet infrastructure through national and regional Internet exchange points. Such deployment is considered crucial for the development of the internet in Africa, generating huge costs savings by keeping local traffic local and offering better quality of service and new applications opportunities. AXIS activities included technical assistance on planning, regulatory/policy issues, as well as human training to achieve this objective. Initial funding of € 5 million was secured in 2010 from the EU-Africa Infrastructures Trust Fund as one of the projects funded under the first Action Plan of the 8th Africa-EU Strategic Partnership. The African Union (AU) Department for Infrastructure and Energy managed this project as part of the Programme for Infrastructure Development in Africa with technical support from the Internet Society.

AXIS focused on African Member States who did not already have Internet Exchange Points (IXPs) in place, commencing with a series of best practice workshops during 2012 and 2013 in Algeria, Benin, Burkino Faso, Burundi, Cameroon, Cape Verde, Chad, Comoros, Congo, Cote d'Ivoire, Gabon, Gambia, Guinea, Liberia, Mali, Madagascar, Mauritius Mauritania, Namibia, Niger, Senegal, Seychelles, Sierra Leone, Swaziland and Togo, followed by Technical Workshops to build local capacity. Internet Exchange Points were set up in Namibia, Burundi, Swaziland and Gambia in 2014, Seychelles, Mauritius and Liberia in 2015, Madagascar in 2016 and Senegal in 2017.

As at September 2017 the number of AU Member States with IXPs has increased from eighteen to thirty-two (Angola, Benin, Botswana, Burkina Faso, Burundi, Congo Republic, Cote D'Ivoire, DR Egypt, Gabon, Gambia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mozambique, Mauritania, Mauritius, Namibia, Nigeria, Rwanda, Seychelles, South Africa, Sudan, Swaziland, Tanzania, Tunisia, Uganda, Zambia and Zimbabwe). Following open tenders, grants were awarded to eight national IXPs to become regional IXPs - Kenya, Rwanda (East Africa), South Africa, Zimbabwe (Southern Africa), Congo, Gabon (Central Africa), Egypt (North Africa) and Nigeria (West Africa).

Table 1 below provides an overview of existing and planned eInfrastructure from the perspective of access to submarine cables, national ICT Backbone, Internet Exchange Points, PKI, National Education and Research Network, participation in AfricaConnect / AfricaConnect 2, telecentres/community centres and status of Universal Access Funds in the IST-Africa Partner Countries.

**Table 1: Overview of ICT Enabling Environment in IST-Africa Partner Countries**

IST-Africa Partner Country	Access to Submarine cables	National ICT Backbone	Internet Exchange Point	PKI	National Education and Research Network	Participation in AfricaConnect/ AfricaConnect 2	Tele-centres/ Community centres	Universal access fund (operational)
Botswana	EASSy, WACS	Fibre optic	BINX (2005)	Ongoing activity.	No	No	190 Govern/NGO 95 PTO Mascom 52 Post Office	Yes
Burundi	EASSy, TEAMS	Fibre optic	Launched March 2014	No	BERNET (est. 2014 – 15 members)	Yes	Emerging	No
Cameroon	SAT3. WACS, MAINONE	Fibre optic	Completed, pending official inauguration	Yes	RIC	AfricaConnect 2	150 operational; 30 being put into service and 15 under construction	Sources of funding include levies on telecom operators
Egypt	FLAG, SMW4 and SMW3	Fibre optic	CAIX (est. 2002)	Yes	EUN/ENSTINET	No	126 IT Houses and 2,163 IT Clubs	No
Ethiopia	SEACOM	Fibre optic	Being studied	Ongoing activity	EthERNET (est. 2001 – 37 Members)	Yes	300 Community Information Centres	Government funded
Kenya	TEAMS, SEACOM, EASSy, LION	Fibre optic	Yes	Yes	KENET (est. 1999)	Yes	61 Pasha Centres	Yes (est.2009)
Lesotho	EASSy, WIOCC	Mix of copper cables, fibre optic cables and satellite	Yes (est. 2014)	Yes	No	No	5 operational and 6 under construction	Yes
Malawi	EASSy (through Tanzania and Mozambique)	Fibre optic cables	Yes (est. 2008)	Yes	MAREN (est. 2005)	Yes via MAREN	56 telecentres est 2010 - 2013	Yes
Mauritius	SAFE, LION, SEACOM	Fibre optic	Yes (est 2006)	Yes	No	No	free internet access in 236 computer clubs and 100 public access points in Post Offices	Yes

IST-Africa Partner Country	Access to Submarine cables	National ICT Backbone	Internet Exchange Point	PKI	National Education and Research Network	Participation in AfricaConnect/ AfricaConnect 2	Tele-centres/ Community centres	Universal access fund (operational)
Mozambique	EASSy, SEACOM	Mix of VSAT, fibre optic connection to all 11 provincial capitals including more than 60 district, satellite	Yes	Ongoing activity	MoRENet (est. 2005)	Yes	60 Community Multimedia centres in operation and 40 in the process of being established	(FSAU) Universal Access Service Fund
Namibia	WACS, ACE, SEACOM	Nationwide terrestrial fibre backbone infrastructure	Yes (WIXP est. 2014)	Bill under development Electronic Transactions and Cybercrime Bill under preparation	XNET (est. 2004)	No	Multipurpose community centres in existence - re-named to Rural ICT Centers (RICTCs)	Universal Service Fund being implemented
Senegal	Atlantis 2, SAT3/WASC/SAFE and Africa Coast	Under construction	Yes (SENIX, est. August 2017)	Under development	SnREN (est. 2011) all public universities are connected by optical fiber with a bandwidth of 2 x 155 MB	Yes via ASREN (AfricaConnect 2)	30 Multimedia Community Centres	Yes
South Africa	ACE, EAASy, WACS, SEACOM, SAT-3 / WASC and SAFE	Nationwide terrestrial fibre backbone infrastructure plus Radio links	CINX, DINX, NAPA-CT1, NAPA-DB1, GINX, JINX and NAPA-JB1	Yes	SANReN (est 2006).	Yes	Telecentres and Thusong Service Centres (Multi-Purpose Community Centres) in existence	Yes
Swaziland	No	fibre optic backbone network	Yes (est. 2014)	Under preparation	No	No	No	No
Tanzania	SEACOM	Construction almost finished	Yes (est. 2004)	Under development	TERNET (est. 2008)	Yes via TERNET	20 telecentres	Yes (UCSAF)
Tunisia	SEA-ME-WE4, KELTRA 2, Didon cable	Fibre optic	Yes	Yes	Réseau National Universitaire	Yes via ASREN (AfricaConnect 2)	Tele-centres and cyberparks in most towns and villages	Framework in place

IST-Africa Partner Country	Access to Submarine cables	National ICT Backbone	Internet Exchange Point	PKI	National Education and Research Network	Participation in AfricaConnect/ AfricaConnect 2	Tele-centres/ Community centres	Universal access fund (operational)
Uganda	TEAMS, SEACOM and EASSy	NBI and EGI in place	Yes (UiXP est. 2003)	Yes – ongoing activity	RENU (est. 2006)	Yes via RENU	154 in existence	Yes (RCDF)



The next section provides an overview of national research priorities, priority areas identified in the context of the Horizon 2020 ICT-39 Call and a mapping of research and innovation expertise to Horizon 2020 Themes.

1.4 National Research Priorities and Mapping to Horizon 2020

In an African context, ICT must be seen as a horizontal enabler in all areas of service delivery – including eHealth, eGovernment, eAgriculture, eEnvironment, eEducation and eInfrastructures. This requires a multidisciplinary approach involving thematic experts, computer scientists and user interface experts for example. The ability to deliver key services via mobile phones is also critical.

Important research areas that are common across most IST-Africa Partner Countries include

- Health (including eHealth, Health Informatics, Telemedicine, Improved diagnosis, mathematical modelling for epidemiology, Medical image processing, Big data analytics for Healthcare, Tools to support self-management of health, Tools to support primary health care workers, Bio-Informatics, Research related to Malaria, HIV, Cancer, Diabetes and Tropical diseases)
- Food Security and Sustainable Agriculture (including Agri-food, Sustainable Food production systems, Water management and sensors, bio-based industries, Information systems to support sustainable natural resources management, Crop production, Forestry, Medical plants)
- Environment & Energy (including Renewable Energy, Smart Electricity Grids, Low-cost devices for energy provision, Smart Metering, Smart Cities, Reducing energy consumption and carbon footprints through smart and sustainable use, Energy efficient design, Solar energy, Energy harvesting, Green ICT, Wind energy solutions, Climate Change and Advanced Sensor Networks)
- Technology-enhanced Learning (including eSkills, Blended Learning, frameworks to support development of content objects, personalised learning)
- CyberSecurity
- Cloud Computing

While each country is addressing a number of national research priorities as outlined in Table 2 below, Diagram 1 provides a visual overview of the main priorities currently being addressed.

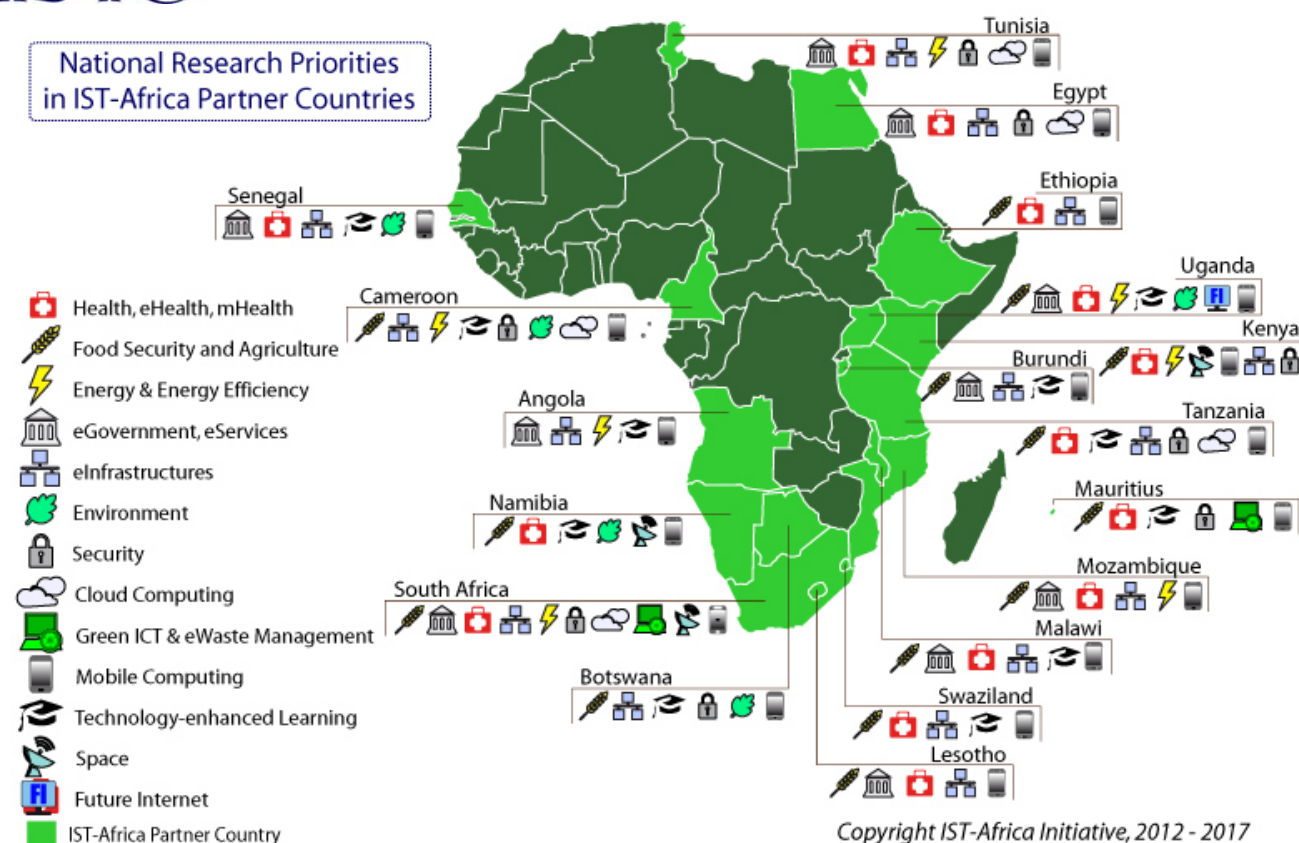


Diagram 1: Overview of National Research Priorities

Table 2: National Research Priorities in IST-Africa Partner Countries

IST-Africa Partner Country	National Research Priorities include:
Botswana	eInfrastructures, Technology-enhanced Learning, Sustainable Agriculture & Food Security, Entrepreneurship, Cyber Security, Energy and Water Ecosystem, Sustainable Development and Climate Change, eHealth
Burundi	eInfrastructures, ICT in Education, eGovernment Services, Agro-Food Technology, Medical Science, Energy, Water, Environment, Biotechnology and Indigenous Knowledge
Cameroon	eInfrastructures, Cyber Security, Connected Enterprises, Cloud Computing, Technology-enhanced Learning, Sustainable Agriculture, Energy, Biotechnology, Environment, Culture, eHealth, Forestry, Tourism, Mining
Egypt	Technology Innovation and Entrepreneurship; Biomedical Informatics Research; Digital Identity; Basic Infrastructure (Broadband, Cloud Computing, Submarine Cables); Cyber Security & eSignature; Information Infrastructure & Digital Content; Electronics Design and Manufacturing
Ethiopia	eInfrastructures; eHealth; Natural Language Processing; Big Data; Indigenous Knowledge; eAgriculture
Kenya	eAgriculture, eHealth, Technology-enhanced Learning, Space Science and Energy; eInfrastructure; Cyber Security, eTourism

IST-Africa Partner Country	National Research Priorities include:
Lesotho	eInfrastructures, eGovernment, eHealth, Technology-enhanced Learning, eAgriculture
Malawi	eHealth, eAgriculture, eInfrastructure, Entrepreneurship, eGovernment, Technology-enhanced Learning, Digital Libraries & Repositories
Mauritius	ICT Energy Efficiency, eWaste Management, eAgriculture, Bio-informatics, Biometric Security, Context Awareness, eHealth, Technology-enhanced Learning, Digital Enterprise (entrepreneurship)
Mozambique	eHealth, Food Security and Agriculture, Future Internet, Energy, Technology-enhanced Learning, eGovernment, ICT for Rural Development and Entrepreneurship.
Namibia	eHealth, mHealth, Food Security and Agriculture, Energy & Energy Efficiency, eGovernment, eServices, Digital content, eInfrastructure, Environment, Technology enhanced learning, Cyber Security and privacy, eTourism
Senegal	eGovernment, eInfrastructures, Entrepreneurship, Digital Divide, eHealth, Technology-enhanced Learning,
South Africa	mHealth, eServices, Environment, Water and Waste, Food Security and eAgriculture, Trust and Security, Space, Climate Change, Future Internet (Internet of Things), Cloud Computing, Advanced Sensor Networks, Technology-enhanced Learning, Energy and Energy Efficiency, Robotics and Machine Learning/Artificial Intelligence, Data Science, Future Wireless Broadband Technologies and Applications, Digital Identity, Advanced manufacturing, Mobile computing.
Swaziland	eHealth, eAgriculture & Food Security, eInfrastructures, Environment, Entrepreneurship
Tanzania	eInfrastructures, Cloud Computing/ High Performance Computing, Cyber Security, Mobile Computing, ICT for Creativity and Learning, eHealth, eAgriculture
Tunisia	eHealth, eInfrastructures, eAgriculture, Smart Cities, eGovernment, Cyber Security, Services and Trusted Networks, eServices and Knowledge Economy, Cloud Computing and ICT for Energy Efficiency
Uganda	eHealth, Food Security and Sustainable Agriculture, Energy, Environment, Future Internet, eGovernment, Digital Content, Technology-enhanced Learning, Robotics, Bioinformatics, Climate change and Energy Efficiency

Diagrams 2 below provides visual representation of priority themes in the context of the ICT-39 H2020 Calls (focused on collaborative research and innovation projects addressing the needs of end-user communities in Africa).



Diagram 2 Horizon 2020 ICT-39 Priority Themes in IST-Africa Partner Countries

Table 3 below provides an overview of the thematic areas of highest priority in the context of the ICT-39-2017 Horizon 2020 Calls and future ICT-39 Calls. While there are some thematic areas that are common across most of the IST-Africa Partner Countries such as eHealth, eAgriculture or Technology-enhanced Learning, there are also additional thematic areas in some countries based on national research capacity.

Table 3: Thematic areas of highest priority for ICT-39-2017

IST-Africa Partner Country	Thematic areas of highest priority to ICT-39
Angola	eHealth; eAgriculture; Environment
Botswana	eHealth, eAgriculture, Technology-enhanced Learning, Energy and Water Ecosystem, Sustainable Development and Climate Change
Burundi	eHealth; eAgriculture; Energy; Environment; Technology-enhanced Learning; eGovernment
Cameroon	eHealth; eAgriculture; Environment; Technology-enhanced Learning; eGovernment
Egypt	eAgriculture; eHealth; eGovernment; Technology-enhanced Learning; Energy;
Ethiopia	eAgriculture; eHealth; Natural Language Processing and Information Retrieval;
Kenya	eAgriculture; eHealth; eGovernment; Technology-enhanced

	Learning
Lesotho	eAgriculture; eHealth / mHealth; Technology-enhanced Learning; Environment; eGovernment; Infrastructure
Malawi	eHealth; eAgriculture; Technology-enhanced Learning; Environment; eGovernment
Mauritius	Energy; Climate action/Environment; Sustainable Agriculture and Maritime Research; Smart, Green & Integrated Transport; eHealth
Mozambique	eHealth; eAgriculture; Technology-enhanced Learning; Environment; eGovernment, Cyber Security
Namibia	eAgriculture; eHealth; Technology-enhanced Learning; eGovernment;
Senegal	eHealth; Environment
South Africa	eAgriculture; eHealth; Technology-enhanced Learning; Environment; eGovernment; Digital Inclusion, Environment/Climate Change, Internet of Things, Cloud Computing, Cyber Security
Swaziland	eAgriculture; eHealth; eGovernment; Environment
Tanzania	eAgriculture; eHealth; Environment/Climate Change
Tunisia	eAgriculture; eHealth; Energy & Energy Efficiency; Environment; eGovernment; Technology-enhanced Learning
Uganda	eAgriculture; eHealth; Technology-enhanced Learning; Environment

Diagram 3 below provides a mapping of North, Central, East and West African institutions in IST-Africa Partner Countries to common research priorities in the context of the ICT-39 call. Diagram 4 below provides a mapping of Southern African institutions in IST-Africa Partner Countries to common research priorities in the context of the ICT-39 call.

Tables 4 & 5 below provide an overview of some of the main institutions, research areas of interest and mapping to Leadership in Enabling and Industrial Technologies (LEIT) & Societal Challenges under Horizon 2020. This overview is designed to help interested parties to quickly identify potential partners in specific thematic areas. Please read the individual country chapters for more detailed information in relation to research capacity.

Mapping of Institutions to Common Research Priorities North, Central, East and West Africa (IST-Africa Partner Countries)

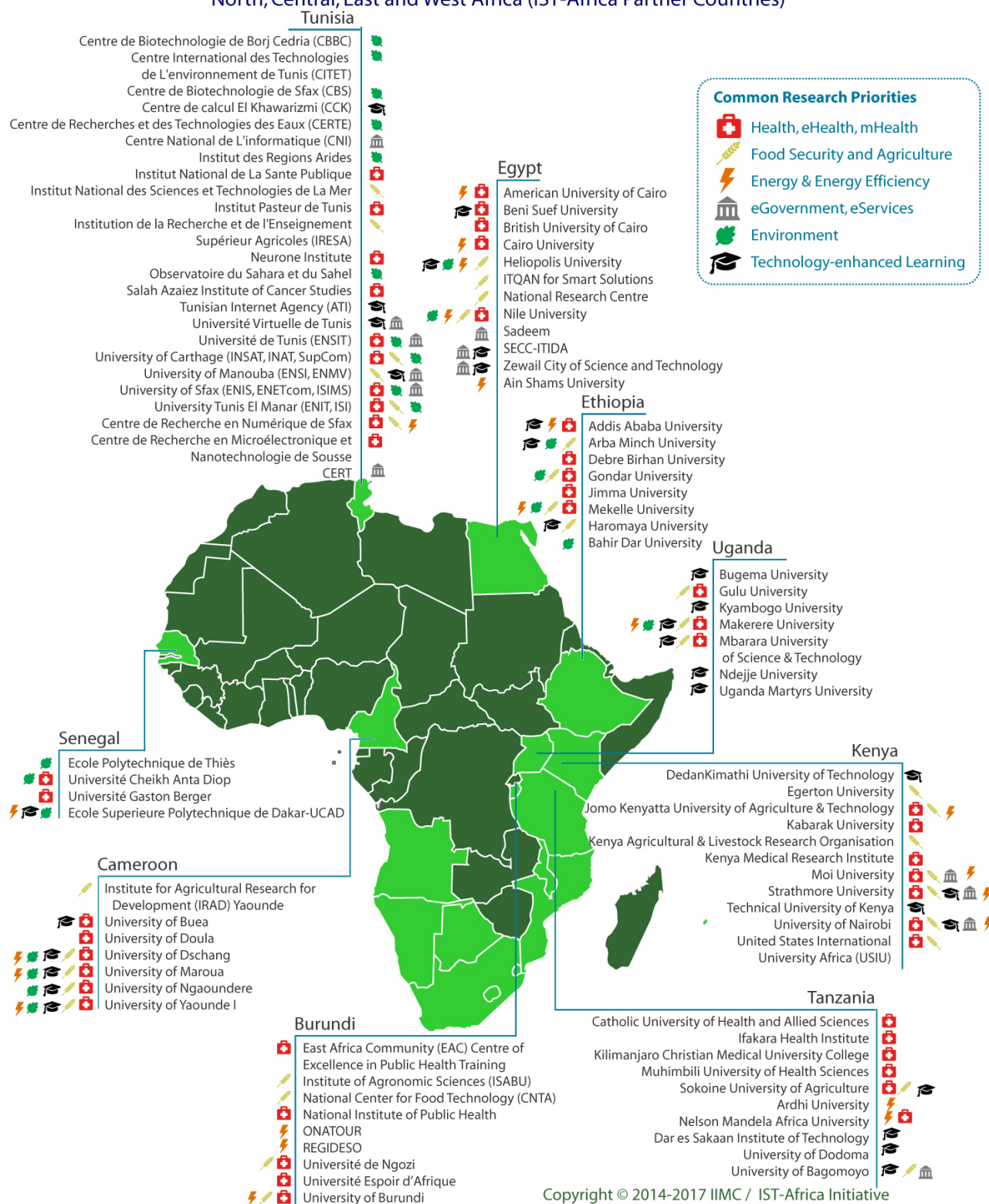
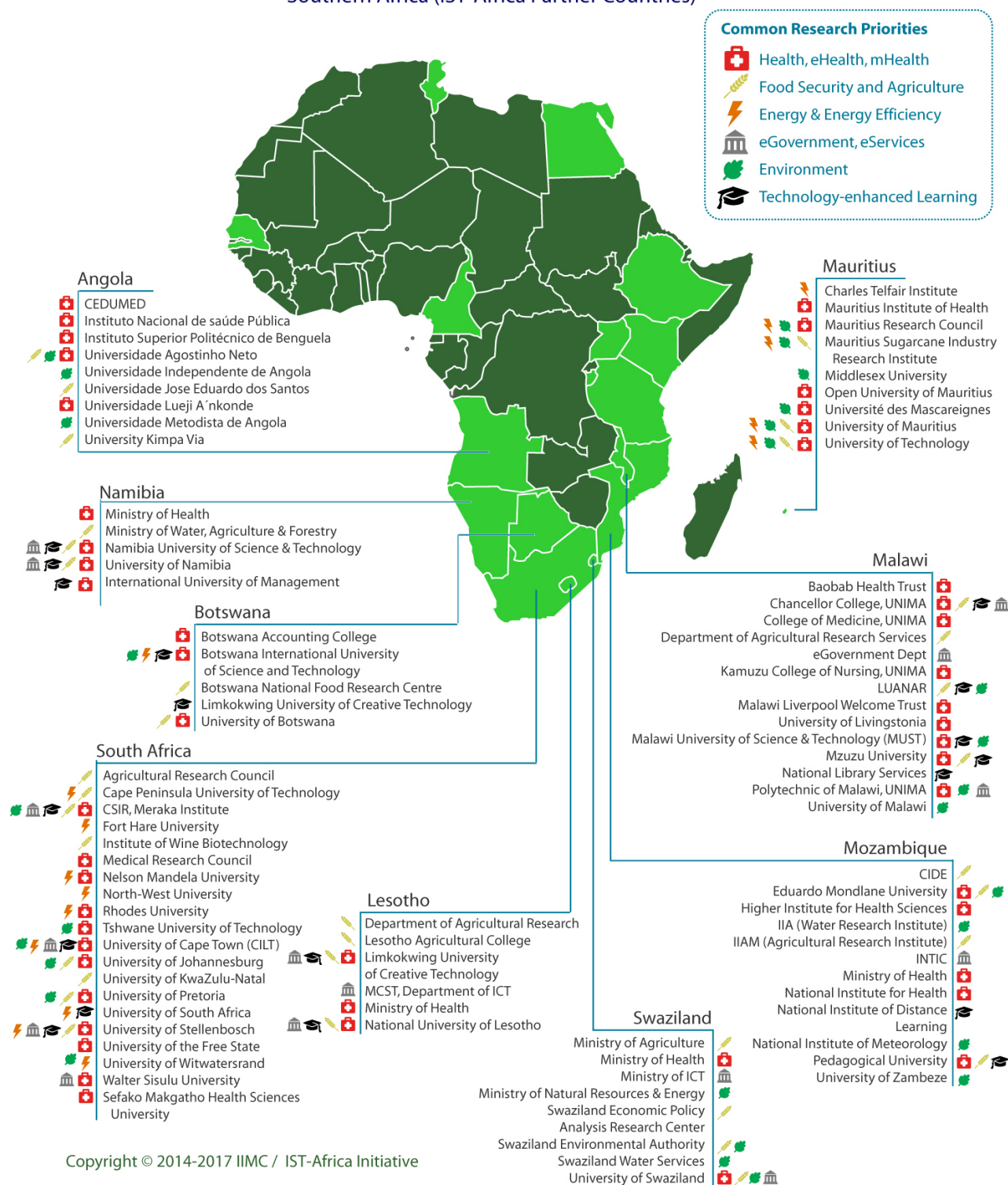


Diagram 3: Mapping of North, Central, East and West Africa Institutions to Common Research Priorities (ICT-39) (IST-Africa Partner Countries)

Mapping of Institutions to Common Research Priorities Southern Africa (IST-Africa Partner Countries)



**Diagram 4: Mapping of Southern African Institutions to Common Research Priorities (ICT-39)
(IST-Africa Partner Countries)**

Table 4: Mapping of Research Expertise in relation to LEIT areas under Horizon 2020 in IST-Africa Partner Countries

Country	LEIT Areas of Most Relevance	Institutions include
Botswana	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management	University of Botswana (Department of Computer Science) Limkokwing University of Creative Technology (Faculty of ICT) Botswana International University of Science and Technology (CITE & MEGE Depts.) Botho University (Faculty of Computing) Botswana Accounting College (Dept. of Computer and Information Systems)
Burundi	Future Internet, Content Technologies & Information Management	University of Burundi (ICT Dept, Polytechnics Dept, Dept of Maths.) Université Lumière de Bujumbura (Faculty of Communications and Information Technology) INITELMATIQUE Université de Ngozi (Faculty of Maths and Informatics)
Cameroon	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management, Robotics	University of Beau (College of Technology; Faculty of Sciences, Dept of Maths and Computer Science) University of Douala (Dept of Maths and Informatics and Faculty of Engineering) University of Dschang (Dept of Maths and Computer Science) University of Maroua (ISS, Dept of Computer Science) University of Ngaoundere (Dept of Maths and Computer Science) University of Yaounde I (ENSP, Faculty of Sciences, Dept of Maths and Computer Science)
Egypt	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management, Robotics, Nano-Electronics	Beni Suef University (Faculty of Computers and Information) Cairo University (Depts of Information Technology, Computer Science, Electrical and Communication, Applied National Institute of Science, Systems and Biomedical) ITIDA - SECC American University in Cairo (AUC) (Depts of Computer Science & Engineering, Electronics Engineering) British University in Egypt (BUE) (Faculty of Informatics and Computers Science) Ain Shams University Helwan University (Faculty of Computers and Information Systems) Heliopolis University (Faculty of Engineering) Nile University (Schools of Communications and IT, Engineering and Applied Sciences, Nano Electronics Integrated Systems Centre, Wireless Intelligent Networks) Arab Academy for Science, Technology & Maritime Transport (Depts of Electronics and

Country	LEIT Areas of Most Relevance	Institutions include
		<p>Communications, College of Computing and Information Technology)</p> <p>Azhar University (Dept of Computer Engineering)</p> <p>National Telecommunication Institute (Depts. of Networks, Electronics)</p> <p>Egyptian National Scientific and Technical Information Network (ENSTINET)</p> <p>Zewail City of Science and Technology (Smart Systems)</p>
Ethiopia	<p>Components & Systems,</p> <p>Advanced Computing, Future Internet, Content Technologies & Information Management,</p> <p>Cloud Computing, Wireless Networking</p>	<p>Addis Ababa University (Institute of Technology, IT Doctoral Programme, School of Info Sciences)</p> <p>University of Gondar (Dept of Computer Science, School of Technology)</p> <p>Haramaya University (Depts of Computer Science, Information Systems, Information Science, Information Technology, Software Engineering)</p> <p>Mekelle University (Ethiopian Institute of Technology)</p> <p>Arba Minch University</p> <p>HiLCoE School of Computer Science and Technology College</p> <p>ICT Centre of Excellence</p> <p>Jimma University</p> <p>Bahir Dar University</p> <p>Adama S&T University</p>
Kenya	<p>Components & Systems,</p> <p>Advanced Computing, Future Internet, Content Technologies & Information Management</p>	<p>University of Nairobi (Schools of Computing and Informatics, Engineering, FabLab)</p> <p>KCA University (Faculty of Computing and Information Management)</p> <p>Jomo Kenyatta University of Agriculture and Technology(JKUAT) (Depts of Computing, IT, Telecoms)</p> <p>Strathmore University (Faculty of Information Technology, @iLabAfrica)</p> <p>Moi University (Schools of Engineering, Information Technology)</p> <p>Egerton University (Faculty of Engineering & Technology)</p> <p>Kenyatta University (School of Engineering & Technology)</p> <p>Kenya Education and Research Network (KENET)</p> <p>United States International University</p> <p>University of Embu</p> <p>University of Eldoret</p>
Lesotho	<p>Advanced Computing, Future Internet, Content Technologies & Information Management</p>	<p>National University of Lesotho (Dept of Maths and Computer Science)</p> <p>Limkokwing University of Creative Technology (Dept of Computer Techhnology)</p> <p>Lesotho College of Education</p>

Country	LEIT Areas of Most Relevance	Institutions include
Malawi	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management	Chancellor College, University of Malawi (Dept of Computer Science, Department of Physics) Polytechnic, University of Malawi (Dept of Computing and Information Technology) National College of Information Technology College of Medicine, University of Malawi Mzuzu University (Dept of Information Sciences and Communication) Kamuzu College of Nursing, University of Malawi (Community and Mental Health Dept)
Mauritius	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management, Robotics	University of Mauritius (Depts of Computer Science and Engineering, Mechanical and Production Engineering) University of Technology Mauritius (Schools of Innovation, Technology & Engineering, Sustainable Development and Tourism) Université des Mascareignes (Faculty of Engineering – ICT) Middlesex University of Mauritius Charles Telfair Institute Open University of Mauritius Mauritius Research Council
Mozambique	Future Internet, Content Technologies & Information Management	National Institute of Information and Communication Technology (INTIC) Instituto Nacional das Comunicações de Moçambique (INCM) Eduardo Mondlane University (Depts of Engineering and Informatics, CIUEM) Mozambique ICT Institute (MICTI) Catholic University (Dept of Information Technology) National Institute for Education Development (INDE) Pedagogical University (UP)
Namibia	Future Internet, Content Technologies & Information Management, Robotics, Components & Systems, Advanced Computing,	Namibia University of Science and Technology (School of Information Technology) University of Namibia (Depts of Computer Science, Electronics and Telecommunication Engineering, Multidisciplinary Research Centre) International University of Management
Senegal	Components & Systems, Future Internet, Content Technologies & Information Management, Robotics	Université Cheikh Anta Diop Université Gaston Berger Ecole Polytechnique de Thiès Université de Bambey Université de Ziguinchor

Country	LEIT Areas of Most Relevance	Institutions include
		Ecole Supérieure Polytechnique de Dakar-UCAD Université virtuelle du Sénégal
South Africa	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management, Robotics	Cape Peninsula University of Technology (Depts of Electrical, Electronic and Computer Engineering; Industrial & Systems Engineering; Information and Communications Technology Academy; Informatics and Design) University of the Witwatersrand (Dept of Electrical and Electronics Engineering Science; Academy of Computer Science and Software Engineering) University of Cape Town (Depts of Electrical Engineering, Computer Science & Information Systems, Centre for Information Technology) University of the Western Cape Council for Scientific and Industrial Research (Meraka Institute; Modelling and Digital Sciences (MDS); and the Defence, Peace, Safety and Security (DPSS)) University of Zululand (Depts of Computer Science and Information Systems) University of Free State (Dept of Computer Science & Informatics) University of Pretoria (Depts of Computer Science, Informatics and Information Science; Systems Engineering, Electronic and Computer Engineering) University of Johannesburg (Depts of Electrical and Electronics Engineering Science; Academy of Computer Science and Software Engineering) University of KwaZulu Natal (Schools of Maths, Statics & Computer Science, Computer Engineering, Electrical Engineering) Rhodes University (Depts of Computer Science; Information Systems; Physics and Electronics) Nelson Mandela Metropolitan University (Depts of Electrical Engineering; School of Information and Communication Technology, Computer Science; Institute for ICT Advancement) University of Stellenbosch (Depts of Electrical and Electronics Engineering; Computer Science; Centre for Languages and Speech Technology) Tshwane University of Technology (Depts of Electrical Engineering, Computer Engineering, Computer Networks, System Development, ICT Management) University of Fort Hare (Dept of Computer Science & Information Systems) North West University (Schools of Electrical, Electronic, Information Systems and Computer Science; Information Technology; Mathematics and Physical Science)
Tanzania	Components & Systems, Advanced Computing, Future Internet, Content Technologies	Dar es Salaam Institute of Technology (Centre for ICT Excellence) University of Dar es Salaam (School of Informatics & Communication Technologies; College of Engineering; University of Computing Centre)

Country	LEIT Areas of Most Relevance	Institutions include
	& Information Management, Robotics	University of Dodoma (School of Informatics) State University of Zanzibar Institute of Financial Management St Joseph's University Open University of Tanzania Nelson Mandela University Arusha (Schools of Computational & Communication Science & Engineering; Applied Maths & Computational Science; Information Technology Development & Management; Communication Science & Engineering) Ardhi University (Centre for ICT) Muslim University of Morogoro Sokoine University of Agriculture University of Bagamoyo
Tunisia	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management, Robotics, Internet of Things, Cloud Computing, Big Data	University of Tunis El Manar (National School of Engineers of Tunis (ENIT), Faculty of Sciences of Tunis) University of Tunis (Higher School of Sciences and Techniques of Tunis, ENSIT) University of Cathage (Polytechnic School of Tunisia (EPT), Higher School of Communications Technology (SupCom); National Institute of Applied Sciences and Technology (INSAT); Higher School of Technology & Computer Science of Carthage (ENICAR) University of Manouba (National School of Computer Sciences (ENSI) University of Sousse (Higher School of Engineers of Sousse (ENISO) University of Monastir (National School of Engineers of Monastir (ENIM) University of Sfax (National School of Engineers of Sfax (ENIS) University of Gabes (National School of Engineers of Gabes (ENIG) Centre de Recherche en Numérique de Sfax (CRNS) Centre de Recherche en Microelectronique et Nanotechnologie (CRMN) Centre D'etudes et de Recherches de Telecommunications (CERT) Centre National de L'informatique (CNI)
Uganda	Computing, Future Internet, Content Technologies & Information Management, Robotics, Smart Embedded Components	Makerere University (Faculty of ICT, Business School, East African School of Library and Information Science) Uganda Christian University Uganda Martyrs University Mbarara University of Science and Technology (Depts. of Computer Engineering, Computer Science, Information Technology, Software Incubation)

Country	LEIT Areas of Most Relevance	Institutions include
		Gulu University Uganda Technology Management University

Table 5: Mapping of Research Expertise in relation to Societal Challenges under Horizon 2020 in IST-Africa Partner Countries

Country	Societal Challenges of Most Relevance	Institutions include
Botswana	Health; Food Security and Agriculture, Energy, Transport, Secure Societies	<p>Health - University of Botswana (School of Medicine); Botswana International University of Science and Technology (CITE Dept), Botswana Accounting College (Dept of Computing and Information Systems)</p> <p>Agriculture - University of Botswana, Botswana National Veterinary Laboratory, Botswana National Food Research Centre</p> <p>Energy - Botswana International University of Science and Technology (MEGE Dept)</p> <p>Transport - Botswana International University of Science and Technology (MEGE Dept)</p> <p>Secure Societies - Botswana International University of Science and Technology (Applied Sciences); Botho University (Faculty of Computing)</p>
Burundi	Health; Food Security and Agriculture, Energy	<p>Health - University of Burundi (Faculty of Medicine); National Institute of Public Health (INSP); Université de Ngozi (Health Science Institute/Faculty), Université Espoir d'Afrique (Faculty of Medicine); Institut Universitaires des Sciences de la Santé et du Développement Communautaire (Filière de Soins Infirmiers, de Sage-Femme, de Pharmacie, de Laboratoire, de Gestion des Services de Santé), Institut Universitaire des lacs de Kirundo (Filière des soins infirmiers) Ecole Supérieure des Sciences de la Santé de Kinindo (Filière de Santé Mentale et Psychiatrie, Soins Infirmiers), Institut Supérieur Paramédical de Gitega (Filière de Santé Publique, de Soins Infirmiers et de Sage-Femme), East Africa Star University (Filière de Santé communautaire, de Santé Publique), Université lumière de Bujumbura (Filières de Santé Publique et Gestion des Services de Santé, Sciences Infirmières)</p> <p>Agriculture - University of Burundi (Faculty of Agronomy and BioEngineering, IRRI); National Center for Food Technology (CNTA); Institute of Agronomic Sciences in Burundi (ISABU); Université de Ngozi (CERADER); AGROBIOTECH</p> <p>Energy – REGIDESO, ONATOUR, University of Burundi</p>
Cameroon	Health; Food Security and Agriculture; Energy; Transport; Environment; Innovative Societies; Secure Societies	<p>Health – University of Dschang (Dept Maths & Computer Science); University of Maroua (Computer/Telecom); University of Ngaoundere (Math/CS); University of Doula (Math/CS); University of Yaounde I (Faculty of Biomedical Science), University of Buea (Faculty of Health Science), University of Bamanenda (Faculty of Health Science)</p> <p>Food Security & Agriculture - University of Maroua (Computer/Telecom); University of Ngaoundere (Math/CS); University of Dschang (Faculty of Agronomy), Institute for Agricultural Research for Development (IRAD) Yaounde</p> <p>Energy – University of Dschang (Dept Maths & Computer Science); University of Maroua (Computer/Telecom); University of Yaounde I (Faculty of Science)</p>

Country	Societal Challenges of Most Relevance	Institutions include
		<p>Transport - University of Maroua (Computer/Telecom)</p> <p>Climate Change & Environment - University of Ngaoundere (Math/CS), University of Yaounde I (Faculty of Science)</p> <p>Inclusive, Innovative & Reflective Societies - University of Maroua (Computer/Telecom), University of Yaounde I (ENSP)</p> <p>Secure Societies - University of Maroua (Computer/Telecom); University of Ngaoundere (Math/CS), University of Yaounde I (ENSP)</p>
Egypt	Health; Food Security and Agriculture; Energy; Transport; Environment; Innovative Societies; Secure Societies	<p>Health - American University of Cairo; Nile University (Center for Informatics Science, Centre for Nanotechnology); Cairo University; Ain Shams University ASU Faculty of Medicine; Information Technology Institute; Academy of Scientific Research and Technology ASRT; ITI, Heliopolis University; Beni Suef University (Faculty of Computers and Information), British University in Egypt</p> <p>Food Security & Agriculture – Nile University (Center for Informatics Science); Heliopolis University (Heliopolis Academy Lab for Biodynamic Agriculture and Medicinal Plants); The Agricultural Research Center; National Research Center; National Institute of Oceanography and Fisheries; Zagazig University</p> <p>Energy – Nile University (Nano Electronics Integrated Systems Centre, Center for Nanotechnology); American University of Cairo; Heliopolis University; New and Renewable Energy Authority; Ministry of Water Resources and Irrigation; Academy of Scientific Research and Technology ASRT; Egypt Japan University for Science and Technology</p> <p>Environment – Nile University (Nano Electronics Integrated Systems Centre, Center for Nanotechnology); Cairo University; Egyptian Environmental Affairs Agency; Ministry of Water Resources and Irrigation, Heliopolis University</p> <p>Transport - Ain Shams University; National Telecommunication Institute</p> <p>Inclusive, Innovation and Reflective Societies – Nile University; Heliopolis University, Bibliotec of Alexandria (CULTNAT)</p> <p>Secure Societies – American University of Cairo, Nile University (Centre for Informatics Science)</p>
Ethiopia	Health; Food Security and Agriculture; Energy; Environment; Secure Societies	<p>Health - University of Gondar (Department of Health Informatics, Institute of Public Health; Dept. of Computer Science, School of Technology); Addis Ababa University; Ethiopian Health and Nutrition Research Institute, Jimma University</p> <p>Food Security & Agriculture - Mekelle University, University of Gondor, Arba Minch University (Department of Computer Science), Ambo University, Haromaya University, Hawasa University</p> <p>Energy – University of Gondar, Mekelle University, Adama University, Adis Ababa University, Addis Ababa Science and Technology University: Sustainable Energy (solar energy, wind & geothermal)</p> <p>Environment - Geological Survey of Ethiopia; Geosas Consulting Service Plc; Arba Minch</p>

Country	Societal Challenges of Most Relevance	Institutions include
		University; Addis Ababa University; Mekelle University; University of Gondar; HiLCOE Secure Societies – Haramaya University; HiLCoE, INSA (Information & Network Security Agency)
Kenya	Health; Food Security and Agriculture; Environment; Energy Efficiency; Transport; Inclusive, Innovative and Reflective Societies	eHealth - University of Nairobi, Jomo Kenyatta University of Agriculture and Technology (JKUAT), Strathmore University (@iLabAfrica), Moi University, United States International University (School of Science and Technology), Kenya Medical Research Institute, Kabarak University Food Security and Agriculture - Moi University, Jomo Kenyatta University of Agriculture and Technology (JKUAT), University of Nairobi, Strathmore University (@iLabAfrica), United States International University (School of Business), Egerton University, Kenya Agricultural and Livestock Research Organisation (KARLO); International Livestock Research Institute (ILRI) Efficient Energy - Strathmore University (@iLabAfrica), JKUAT, University of Nairobi, Moi University Transport - Strathmore University (@iLabAfrica), JKUAT, University of Nairobi Digital Inclusion, eGovernment, eLearning - Strathmore University (@iLabAfrica), Moi University
Lesotho	Health; Agriculture; Energy	Health - National Health Training Centre; National University of Lesotho (Dept of Pharmacy and Nutrition); Limkokwing University of Creative Technology Agriculture – National University of Lesotho (Faculty of Agriculture) Energy – National University of Lesotho (Dept of Mathematics & Computer Science) Innovative Societies - Limkokwing University of Creative Technology Secure Societies - Limkokwing University of Creative Technology
Malawi	Health; Food Security and Agriculture; Environment; Secure Societies	Health - College of Medicine; Kamuzu College of Nursing; Mzuzu University; Chancellor College, University of Malawi; Polytechnic, University of Malawi; MUST Agriculture – LUANAR, Mzuzu University; Lilongwe University of Agriculture & Natural Resources, Dept of Agricultural Research Services Environment - LUANAR; Polytechnic, University of Malawi Energy - LUANAR; Malawi University of Science and Technology (Climate and Earth Science Dept); University of Malawi (Chemistry Dept) Secure Societies - Chancellor College, University of Malawi; Polytechnic, University of Malawi
Mauritius	Health; Sustainable Agriculture; Environment; Energy; Innovative Societies; Secure Societies	Health - University of Mauritius (Dept of Computer Science and Engineering), University of Technology Mauritius (School of Sustainable Development and Tourism), Mauritius Research Council, Université des Mascareignes, Mauritius Institute of Health Sustainable Agriculture - University of Mauritius (Dept of Chemical & Environmental Engineering), University of Technology Mauritius (School of Sustainable Development and Tourism), Mauritius

Country	Societal Challenges of Most Relevance	Institutions include
		<p>Research Council, Mauritius Sugarcane Industry Research Institute</p> <p>Environment, Climate Change - University of Mauritius (Dept of Chemical & Environmental Engineering), University of Technology Mauritius, Université des Mascareignes, Mauritius Sugarcane Industry Research Institute, Middlesex University</p> <p>Energy, Green ICT, Smart Cities – Charles Telfair Institute, University of Mauritius (Dept of Chemical & Environmental Engineering; Dept of Mechanical and Production Engineering), Mauritius Research Council, University of Technology Mauritius (School of Sustainable Development and Tourism), Mauritius Sugarcane Industry Research</p> <p>Innovative Societies - University of Technology Mauritius, Mauritius Research Council, University of Mauritius (Virtual Centre for Innovative Learning Technologies), Charles Telfair Institute, Open University of Mauritius, Université des Mascareignes</p> <p>Secure Societies - Université des Mascareignes, University of Technology Mauritius, Open University of Mauritius</p>
Mozambique	Health; Food Security and Agriculture; Environment	<p>Health - Eduardo Mondlane University UEM (Faculty of Medicine), Higher Institute for Health Science (ISCISA), Pedagogical University (UP)</p> <p>Agriculture - Agrarian Research Institute of Mozambique (IIAM), Ethnobotanical Research and Development Center (CIDE), Pedagogical University (UP)</p> <p>Environment - Instituto Nacional de Meteorologia; Eduardo Mondlane University; IIA (Water Research Institute); University of Zambeze</p>
Namibia	Health; Food Security and Agriculture; Energy; Environment; Inclusive and Reflective Societies	<p>Namibia University of Science and Technology (School of Health and Applied Sciences, School of Natural Resources and Tourism, School of Engineering, Renewable Energy and Energy Efficiency Institute)</p> <p>University of Namibia (Faculty of Health Sciences, Faculty of Agriculture and Natural Resources)</p>
Senegal	Health; Environment; Cultural Resources; Secure Societies	<p>Health - Université Gaston Berger; Université Cheikh Anta Diop, Université de Thiès</p> <p>Environment - Université Cheikh Anta Diop; Ecole Polytechnique de Thiès; Ecole Supérieure Polytechnique de Dakar - UCAD, Université Assane Seck de Ziguinchor</p> <p>Cultural Resources - Ecole Polytechnique de Thiès</p> <p>Secure Societies - Ecole Polytechnique de Thiès</p>
South Africa	Health, Energy, Innovative Societies, Secure Societies, Food Security and Agriculture	<p>Health - Walter Sisulu University; University of KwaZulu-Natal; University of Witwatersrand; University of Pretoria (School of Health Systems and Public Health); CSIR Meraka; Medical Research Council; University of Free State; University of Stellenbosch (Faculty of Health and Medicine); Rhodes University (Natural Products and Medicinal Chemistry Research Group);</p>

Country	Societal Challenges of Most Relevance	Institutions include
		<p>University of Cape Town (Drug Discovery and Development Center), Nelson Mandela University; University of Johannesburg; Tshwane University of Technology, Sefako Makgatho Health Sciences University.</p> <p>Food Security and Sustainable Agriculture - Agricultural Research Council; University of KwaZulu-Natal (Department of Agricultural Engineering); Cape Peninsula University (Functional Foods Research Unit); University of Stellenbosch (Institutes of Plant Biotechnology); Institute of Wine Biotechnology; CSIR Biosciences; University of Johannesburg (Department of Biotechnology); University of Pretoria, University of Zululand</p> <p>Energy - University of South Africa (College of Science, Engineering and Technology); Cape Peninsula University of Technology (Centre for Substation Automation and Energy Management Systems); University of Stellenbosch (Dept of Electrical and Electronics); University of Witwatersrand (Dept of Mechanical, Industrial and Aeronautical Engineering); North-West University (Schools of Mechanical and Nuclear Engineering), Fort Hare University (Institute of Technology); Rhodes University (Biotechnology Innovation Center); University of Cape Town (Energy Research Center); Nelson Mandela University, Council for Scientific and Industrial Research; South African National Energy Development Institute (SANEDI)</p> <p>Innovative Societies - Rhodes University; Fort Hare University; University of Stellenbosch; CSIR Meraka; Tshwane University of Technology; Nelson Mandela University</p> <p>Secure Societies - CSIR MDS and DPSS; University of KwaZulu-Natal; Tshwane University of Technology; University of Stellenbosch; University of Limpopo, University of Pretoria; University of Johannesburg, University of the Witwatersrand; University of Cape Town</p>
Swaziland	Health, Food Security and Agriculture; Environment	University of Swaziland (Department of Health Sciences, Department of Computer Information Systems, Department of Agricultural Research); Swaziland Environmental Authority
Tanzania	Health; Food Security and Agriculture; Energy; Transport; Environment; Innovative Societies; Secure Societies	<p>Health - Ifakara Health Institute; Muhimbili University of Health and Allied Sciences; Catholic University of Health and Allied Sciences; Kilimanjaro Christian Medical University College</p> <p>Agriculture - Sokoine University of Agriculture; Open University</p> <p>Energy - Ardhi University</p> <p>Transport - Ardhi University; National Institute of Transport</p> <p>Environment – Open University</p> <p>Inclusive, Innovative and Reflective Societies – University of Bagamoyo</p> <p>Secure Societies - University of Dodoma; Institute of Financial Management; Dar es Salaam Institute of Technology; University of Bagamoyo</p>
Tunisia	Health; Food Security and Agriculture; Energy; Environment;	Health - Centre en de Recherche en Numérique de Sfax, ENIS; SupCom; ENET'Com, ISIMS,

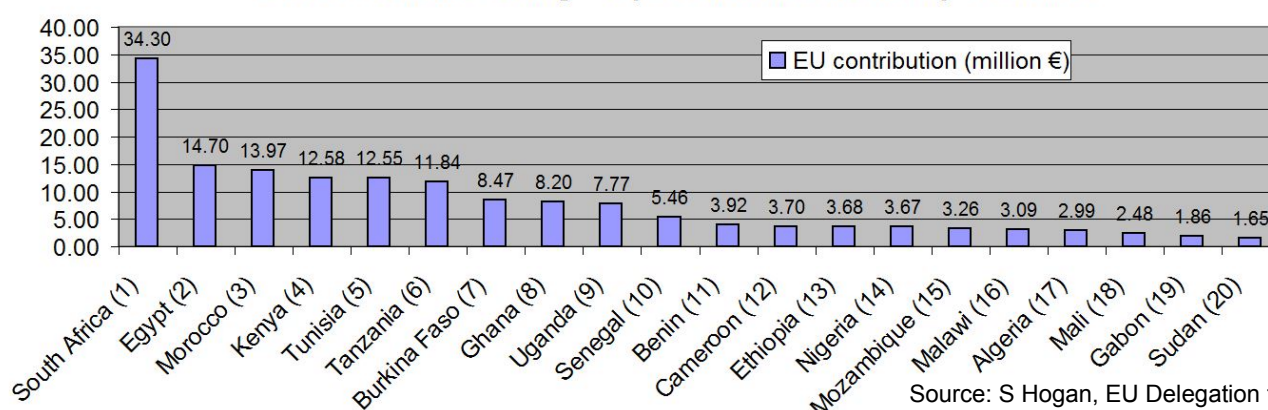
Country	Societal Challenges of Most Relevance	Institutions include
	Transport; Innovative Societies; Secure Societies	<p>ENSIT; Institut Pasteur de Tunis; Institut National de La Sante Publique</p> <p>Food Security & Agriculture - SupCom; INSAT; ENIT; Institut National des Sciences et Technologies de La Mer; Institution de La Recherche et de L'enseignement Superieur Agricoles; Centre de Biotechnologie Borj Cedria; Institut National Agronomique de Tunisie; Ecole Nationale de Médecine Vétérinaire;</p> <p>Energy - Centre de Recherche en Numérique de Sfax; ENIS; SupCom; ENET'Com; ENSI; ENIG, ENIM, EPT, ENSIT; Alternative Energy Systems SARL; Ecole Nationale d'Ingenieurs de Tunis</p> <p>Environment - ENIS; ENIT; Centre International des Technologies de L'environnement de Tunis; Ecole Supérieure des Communications de Tunis; Institut National Agronomique de Tunisie; Observatoire du Sahara et du Sahel; Centre de Biotechnologie de Sfax - CBS; Centre de Biotechnologie de Borj Cedria; Centre de Recherches et des Technologies des Eaux; Université de Tunis; Sfax University; Institut des Regions Arides</p> <p>Transport - ENSI; ENIS; ENSIT, ENIT; Institut Supérieur du Transport et de la Logistique - Sousse</p> <p>Innovative Societies - ENSI; ENIS; ENSIT, INSAT, EPT, CERT, CNI, CRMN; CRNS; Université Virtuelle de Tunis</p>
Uganda	Health; Food Security and Agriculture; Energy; Transport; Environment; eInclusion; Secure Societies	<p>Health - Makerere University; Mbarara University of Science and Technology; Gulu University</p> <p>Agriculture, Energy, Transport, eInclusion, Secure Societies - Makerere University</p> <p>Environment - Geological Survey and Mines; Department of Geothermal Energy, Makerere University</p>

1.5 National Participation in FP7

FP7 Research funding of €171.5 million to 45 African Member States

With the opening up of International Cooperation across all funding instruments and a number of specific thematic calls focused on cooperation with Africa (Africa-2010 Call), there was a considerable increase in participation from African Member States in funded FP7 projects. Research funding of over €171.5 million went into African research institutions in 45 African Member States³. Diagram 5 below highlights countries with the highest levels of FP7 research funding.

FP7 Research Funding - Top 20 African Beneficiary Countries



Source: S Hogan, EU Delegation to AU

Diagram 5: Leading African Countries in terms of FP7 research funding

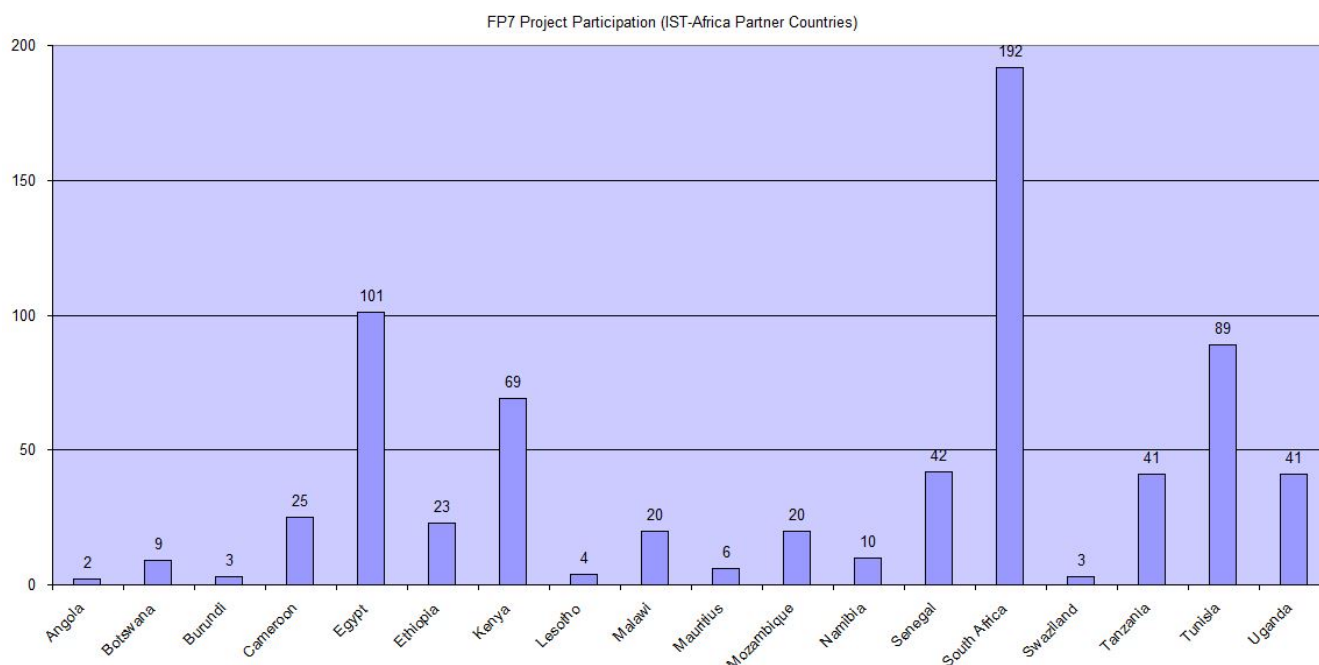


Diagram 6: FP7 Project Participation from IST-Africa Partner Countries

³ FP7 projects included participation from 45 African Member States: Algeria; Angola; Benin; Botswana; Burkina Faso; Burundi; Cameroon; Cape Verde; Central African Rep.; Congo; Congo (DRC); Cote d'Ivoire; Egypt; Ethiopia; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Kenya; Lesotho; Libya; Madagascar; Malawi; Mali; Mauritania; Mauritius; Morocco; Mozambique; Namibia; Niger; Nigeria; Rwanda; Senegal; Seychelles; Somalia; South Africa; Sudan; Swaziland; Tanzania; Togo; Tunisia; Uganda; Zambia; Zimbabwe

The level of participation under FP7 by organisations from IST-Africa Partner Countries grew significantly between 2007 and 2013 as illustrated in Diagram 6 above. This successful participation provides a body of experience and network of collaborators to build upon when targeting collaborative research and innovation opportunities under Horizon 2020.

A detailed analysis of African participation in FP7 is provided in the IST-Africa study “*Guide to Bilateral & Multilateral Cooperation Agreements Supporting ICT/STI-related Activities in IST-Africa Partner Countries*”⁴, January 2014, ISBN: 978-1-905824-42-7.

1.6 National Participation in Horizon 2020, Results from ICT-39-2015 & ICT-39-2017

*H2020
Research &
Innovation
funding to date
of €91.9 million
to 35 African
Member States*

IST-Africa is actively encouraging the participation of African institutions in both general and specific Calls under Horizon 2020 (2014 – 2020).

As at September 2018, there were over 625 participations from 364 organisations across 35⁵ African Member States. Involvement in two hundred and seventy nine (279) Horizon 2020 projects brought research funding in excess of €91.9 million into African research centres and universities. These projects are a mix of Research and Innovation Actions (104), Innovation Actions (25) and Coordination and Support Actions (50), Marie Curie RISE (68), Marie Curie ITN (8), Marie Curie IF (8), Marie Curie Cofund (4), ERC (4) and ERA-NET-Cofund (8). There is good participation across all three pillars of Horizon 2020.

Diagram 7 below highlights the African countries with the highest number of Horizon 2020 funded projects as at September 2018 (IST-Africa analysis of data published on Cordis as at September 2018).

⁴ http://www.ist-africa.org/home/files/IST-Africa_BilateralCooperation_310114.pdf

⁵ Algeria; Angola; Benin; Botswana; Burkina Faso; Burundi; Cabo Verde; Cameroon; Democratic Republic of the Congo; Egypt; Ethiopia; Gabon; Gambia; Ghana; Kenya; Lesotho; Liberia; Libyan Arab Jamahiriya; Madagascar; Malawi; Mali; Mauritius; Morocco; Mozambique; Namibia; Nigeria; Rwanda; Senegal; South Africa; Swaziland; Tanzania; Togo; Tunisia; Uganda; Zambia

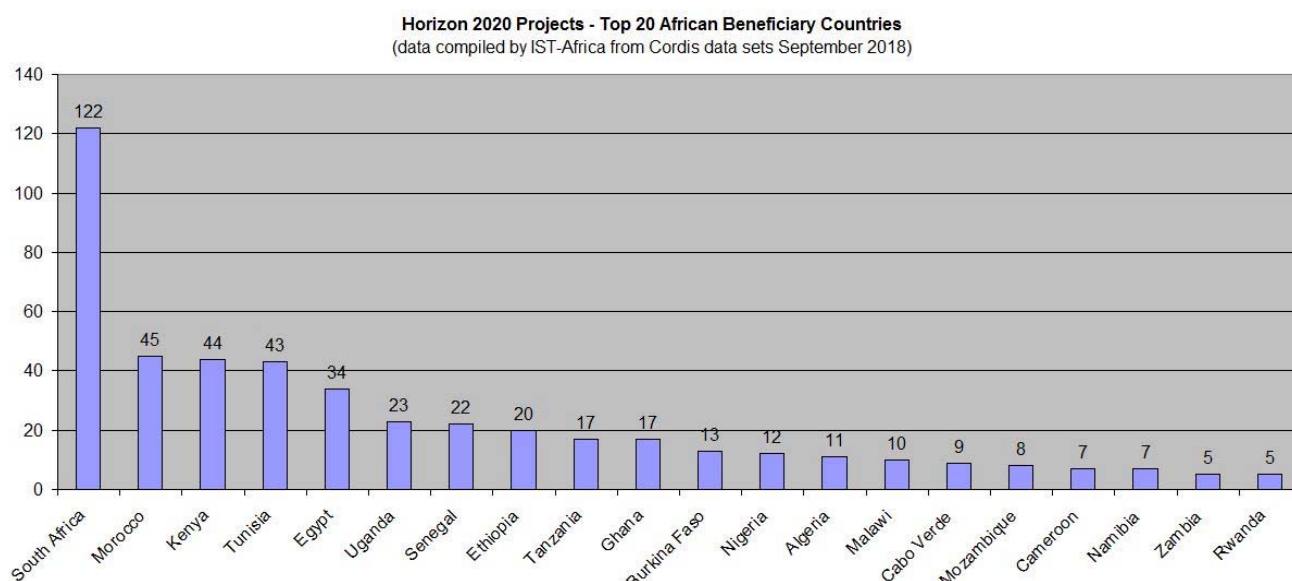


Diagram 7: Leading African Countries in terms of H2020 Projects (September 2018)

Diagram 8 below outlines the participation in funded Horizon 2020 projects by IST-Africa Partner Country as at September 2018:

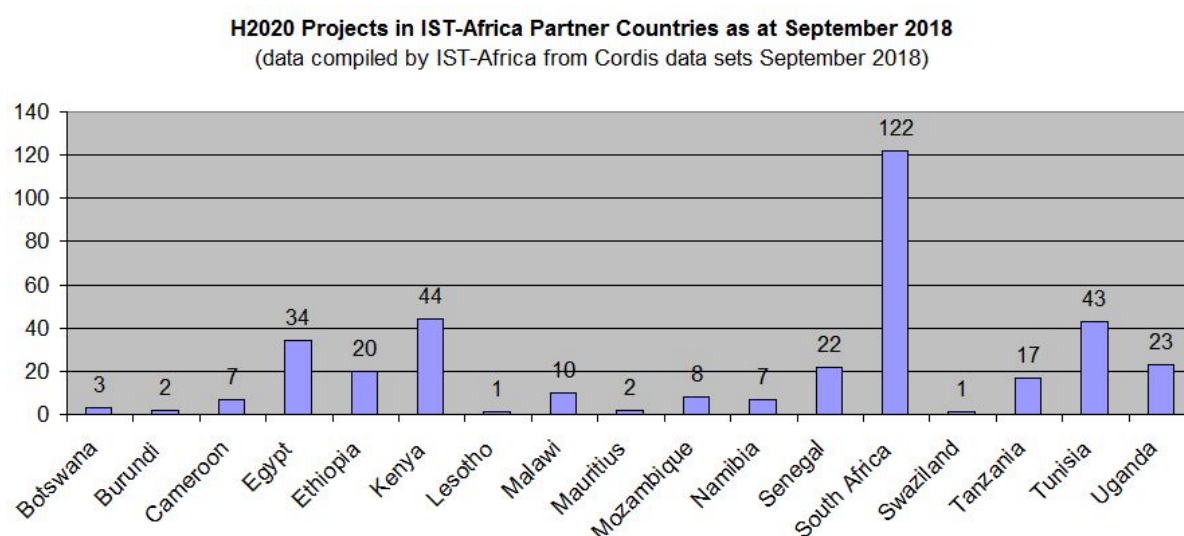


Diagram 8: Horizon 2020 participation by IST-Africa partner country (September 2018)

Over seventy six percent of all participating African organisations in funded Horizon 2020 projects as at September 2018 were from IST-Africa partner countries, securing competitive grant funding of over €69.9 million.

ICT-39-2015 and ICT-39-2017 Calls

As part of its strategy to further grow African participation in internationally funded research, IST-Africa provided evidence to the European Commission to justify and secure €25 million for African-focused research cooperation under the LEIT Work Programme of Horizon 2020 - ICT-39-2015 Research



and Innovation Actions (Horizon 2020 2014 - 2015 Work Programme) and ICT-39-2017 Innovation Actions (Horizon 2020 2016 - 2017 Work Programme).

IST-Africa actively disseminated the Call for Proposals for ICT-39-2015 and ICT-39-2017 to European and African institutions, organised dissemination and training workshops in Europe and Africa, assisted interested parties to identify relevant themes and partners and provided assistance in fine tuning proposals submitted for consideration for funding. Both Calls were very heavily oversubscribed with good quality proposals. This provides clear evidence of the interest of both African and European research institutions to cooperate to address Africa focused research and innovation challenges.

Boxes 3 - 10 below provides insights in the results of the ICT-39-2015 Call and ICT-39-2017 Call with profiles of some of the funded Research and Innovation Actions and Innovation Actions.

Box 3: Horizon 2020 ICT-39-2015 Results

ICT-39-2015 ICT Call of Horizon 2020 was focused on initiating collaborative research and innovation projects addressing the needs of end-user communities in Africa in relevant thematic areas addressed by Horizon 2020 including Content Technologies and Societal Challenges. IST-Africa provided the evidence to justify this call.

IST-Africa actively promoted ICT-39-2015 in Africa and Europe, provided a mapping of research priorities and research capacity in IST-Africa Partner Countries and organised targeted Horizon 2020 Training Workshops in IST-Africa Partner Countries. Helpdesk support was provided to organisations preparing proposals, fine tuning ideas and looking for relevant partners to cooperate with.

The ICT-39-2015 Call was very successful with 45 proposals submitted including 194 participations from Africa out of 439 participations. The proposals submitted were considered to be of high quality and relevant to the focus of the call with 23 proposals over threshold.

Thematic areas addressed by these proposals included eHealth, eAgriculture, Internet of Things, Wireless communications, cloud computing, big data, eLearning, language technologies, green transport, clean energy, network technologies, smart cities and eInclusion.

African countries with highest number of participants in proposals included South Africa (36), Kenya (22), Tanzania (18), Uganda (15), Ghana (13), Senegal (13), Ethiopia (9), Cameroon (6), Mozambique (6), Nigeria (6), Namibia (5), Angola (4), Cape Verde (4), Morocco (4), Burkina Faso (3), Gambia (3), Guinea (3), Malawi (3), Mali (3), Niger (3); eight more African countries had either one or two participations.

Four projects were selected for funding with 11 African countries represented of which 6 IST-Africa Partner Countries are represented in all four projects - Ethiopia (3), Kenya (2), Cameroon (1), Malawi (1), South Africa (1) and Senegal (1).

- [DMC-MALVEC](#) – Development of integrated and automated multiplex vector-diagnostic platform for malaria, Led by IMBB-Forth (Greece) with African partners from Cameroon (Organisation de Coordination pour la lutte contre les Endémies en Afrique Centrale), Ethiopia (Jimma University), Zambia (Ministry of Health) and other European partners from Germany, Luxembourg, Italy, Switzerland and UK
- [mHealth4Afrika](#) - Community-based ICT for Primary Healthcare in Africa, Led by IIMC (Ireland) with African partners from Ethiopia (University of Gondar), Kenya (Strathmore University), Malawi (Chancellor College), South Africa (Nelson Mandela University) and other European partners from Norway and Turkey.
- [its4land](#) – Geospatial technology for land tenure security in East Africa, Led by Twente University (The Netherlands), with African partners from Ethiopia (Bahir Dar University), Kenya (The Technical University of Kenya) & Rwanda (Institut d'Enseignement Supérieur de Ruhengeri and Esri Rwanda Ltd) and other European partners from Germany and Belgium
- [WAZIUP](#) - IoT applications for Agriculture, Led by CREATE-Net (Italy) with African partners from Senegal (Uni of Gaston Berge de Saint Louis, CODER4Africa, CTIC Dakar), Burkina Faso (Polytechnic of Bobo-Dioulasso), Ghana (iSpace, Farmerline), Togo (L'Africaine D'Architecture) and other European partners from Germany, France and Portugal.

Boxes 4 and 5 provide insights into two of the Research and Innovation Actions funded under ICT-39-2015 - mHealth4Afrika and its4land.

Box 4: mHealth4Afrika

mHealth4Afrika was funded as a Research and Innovation Action under ICT-39-2015. It runs from November 2015 - April 2019.

mHealth4Afrika is focused on supporting Sustainable Development Goal 3 (Ensure healthy lives and promoting well being for all at all ages) by co-designing a modular, state-of-the-art health information system, designed to improve primary healthcare delivery in resource constrained environments.

It aims to assist primary healthcare facilities to increase

- Quality and impact of care through timely capture of information, systematic storage of important data points in the patient record and improved frequency of follow up
- Frequency of contact with a focus on prevention through the use of state-of-the-art technologies at the point of care
- Accuracy and quality of monthly aggregate program indicators
- Access to educational materials for clinic staff and patients to improve skills

The mHealth4Afrika system is being co-designed with Ministries of Health, district health officers, clinic managers and health workers in primary healthcare facilities in resource constrained urban, rural and deep rural environments in Southern Africa (Malawi, South Africa), East Africa (Kenya) and Horn of Africa (Ethiopia). It integrates Electronic Medical Records and Electronic Health Record functionality with medical sensors and data visualisation tools. It supports the adoption of technology at the point of care.

mHealth4Afrika has made excellent progress in addressing the needs of both participating clinics and Ministries of Health. The current iteration of the platform is being piloted in primary health care facilities in Ethiopia, Kenya, Malawi and South Africa. It provides:

- Clinic related functionality: Patient registration, Patient List, Clinic Appointment lists, Healthworker list, Program access rights
- Patient related functionality: Patient Profile page; Programs included Medical History, Obstetric History, Maternal Program (Antenatal care (ANC), Delivery, Postnatal care), Child Under 5 (Growth & Nutrition, Childhood Illnesses, Immunisation, Vitamin A, Deworming), Tuberculosis, Antiretroviral therapy (ART), Family Planning, Cervical Cancer Screening and general Outpatient Department (OPD); Program reporting for individual patients.

Box 5: its4land - Geospatial technology innovations for land tenure security in East Africa

its4land was funded as a Research and Innovation Action under ICT-39-2015. It runs from February 2016 to February 2020. It aims to develop an innovative suite of land tenure recording tools inspired by geo-information technologies that responds to end-user needs and market opportunities in sub Saharan Africa, reinforcing an existing strategic collaboration between EU and East Africa.

its4land captured user requirements as inputs for the technical and institutional project work through site visits, workshops and empirical data collection in Ethiopia, Rwanda and Kenya. Analysis provided evidence of specific needs, market opportunities and readiness of end-users in the domain of land tenure information recording.

Achievements to date

The first version of the smart sketch maps ontology was based on data collection in Ethiopia, Rwanda and Kenya. Qualitative representation of sketch maps, documentation of extended LADM and a prototype for sketch map alignment has also been developed. The initial small unmanned aerial vehicles (UAVs) flights have been completed in Rwanda and Kenya to trial data acquisition methods. Tool development for automatic cadastral boundary extraction has been completed and mainly tested on data from Germany and Rwanda. Recently the work on developing an image-processing system for hosting the tools for boundary delineation on UAV orthomosaics and a qualitative data processing system for hosting sketch map tools has been accomplished.

Box 5: its4land - Geospatial technology innovations for land tenure security in East Africa

The Publish and Share platform provides a scalable runtime environment, a unified set of services for data management and interaction with tools mentioned above (sketch map, UAV and feature extraction). The development of a governance model has started to support the implementation and sustainable use of the innovative tools in order to meet stakeholders' needs. In parallel, a capacity development model is also being developed to strengthen the necessary skills and competencies so that the innovation process can have sustainable effects.

Box 6: Horizon 2020 ICT-39-2017 Results

ICT-39-2017 ICT Call of Horizon 2020 was focused on initiating collaborative Innovation Actions addressing the needs of end-user communities in Africa in relevant thematic areas addressed by Horizon 2020 including Content Technologies and Societal Challenges. IST-Africa provided the evidence to justify this call.

IST-Africa actively promoted ICT-39-2017 across Africa and Europe and provided a comprehensive mapping of research priorities and research capacity in IST-Africa Partner Countries. IST-Africa organised a series of national training workshops during October - December 2016 in Namibia (26 October), Lesotho (31 October), Swaziland (02 November), Kenya (10 November), Tanzania (14 November), Botswana (17 November), Ethiopia (21 November), Malawi (28 November), Uganda (09 December), Cameroon (09 December) and Mauritius (14 December 2017). Helpdesk support was provided to African and European organisations preparing proposals, fine tuning ideas and looking for relevant partners.

The ICT-39-2017 Call was very successful with 71 Innovation Actions submitted with 659 participations. Participants represented 29 African countries including good levels of participation from IST-Africa Partner Countries: Botswana, Cameroon, Ethiopia, Kenya, Mauritius, Malawi, Mozambique, Namibia, Senegal, Swaziland, Tanzania, Uganda and South Africa. The proposals addressed a wide range of topics incorporating an ICT component across Horizon 2020 thematic areas. The most prevalent thematic areas addressed in the proposals submitted were eHealth and eLearning.

Thirty-three proposals were over threshold, with seven projects short-listed for funding based on the available funding envelope. The thematic areas addressed in the short-listed projects for funding include Cybersecurity, Internet of Things, eAgriculture and eLearning.

Six projects were selected for funding with 11 African countries represented, of which 5 IST-Africa Partner Countries are included: Ethiopia (1), Kenya (4), Tanzania (2), South Africa (1) and Uganda (2):

[Go-GA](#) (Nigeria, Kenya, Benin) - adaptation of Go-Lab Learning ecosystem (STEM)

[EPICA](#) (Kenya, Tanzania, Uganda) – ePortfolio, Skills

[SAMS](#) (Ethiopia) – Remote sensing technology to support beekeepers

[FANFAR](#) (Niger, Nigeria) – Flood forecasting and alerts in West Africa

[WAZIHUB](#) (Ghana, Kenya, South Africa, Tanzania, Uganda) – IoT Innovation Program

[ISOOKO](#) (Kenya, Uganda, Rwanda) - digital technologies to support peace education

Boxes 7 - 10 provide profiles for four of the Innovation Action - Go-GA; EPICA; SAMS and ISOOKO - to provide insights into their objectives and achievements to date.

Box 7: GO-GA - Go-Lab Goes Africa

Go-GA was funded as an Innovation Action under ICT-39-2017. It runs from January 2018 to December 2020. It aims to adapt and pilot the Go-Lab ecosystem and Inquiry-based Learning Methodology for Science Technology Engineering and Mathematics (STEM) initially in Benin, Kenya and Nigeria. It is leveraging outputs from the FP7 GoLab and H2020 Next Lab projects. At a second stage it aims to extend the pilot to four associate countries - Ghana, Senegal, Sierra Leone and Tanzania.

Achievements to date

During the first year of the project, the Go-Lab ecosystem has been adapted and localized to the 3 pilot countries. 285 Nigerian, Benin & Kenyan teachers are now part of the Go-Lab learning community. 105 teachers were selected and trained as Master Teachers so they can train their peers as part of the upcoming Large-Scale Teacher On-Boarding programme. 6 Model Inquiry-Learning Spaces and 150 other standard ILS were created by teachers. 30+ schools are being enrolled to take part in the first GO-GA Pilot from February 2019. An Advisory Board of 10 key education stakeholders in the three pilot countries has been created and we have started drafting our Take Up & Scalability Strategy.

Year 2 will focus specifically on the implementation of the first pilot programme across Kenya, Benin and Nigeria, involving 20 teachers per country each implementing at least 1 ILS as part of their classroom lessons over a 3-week test period. Feedback and pilot data will be collected so that lessons can be learnt to feed into the second pilot starting in the fall of 2019.

Box 8: EPICA

EPICA was funded as an Innovation Action under ICT-39-2017. It runs from January 2018 to December 2020. It aims to adapt and pilot an ePortfolio, which will improve the quality, visibility and availability of new skills.

Achievements to date

During the first year of the project, EPICA has organised open days in: Maseno University, Kenya; Open University of Tanzania; and Makerere University, Uganda to engage with local stakeholders. The ePortfolio Maturity and needs report has been finalised describing the needs and the maturity level in the implementation of the ePortfolio ecosystem. The pedagogical and users' requirements have been collected through the EPICA pilots. Legal and Business requirements have also been collected. Analysis of the Pedagogical, Users', Legal and business requirement is underway and is supporting the definition of technical requirements. The Development of a Roadmap for technological development and the design of the ePortfolio user interface are being developed in accordance to the previous requirements' analysis and both are nearing finalization.

Box 9: Smart Apiculture Management Services (SAMS)

SAMS was funded as an Innovation Action under ICT-39-2017. It runs from January 2018 to December 2020. It aims to develop and refine an open source remote sensing technology and user interaction interface to support small-hold beekeepers in managing and monitoring the health and productivity in their own bee colonies.

Achievements to date

Based on the User Centered Design the core activities of SAMS include the development of marketable SAMS Business Services, the adaption of a hive monitoring system for local needs and usability as well as the adaption of a Decision Support System (DSS) based on an open source system. As a key factor of success SAMS uses a multi stakeholder approach on an international and national level to foster the involvement and active participation of beekeepers and all relevant stakeholders along the whole value chain of bees.

During the first year of the project, UCD Workshops, Advisory Board meetings and the preparation of various deliverables on the topics "UCD-Needs Assessment and Evaluation, Manual on Beehive Construction and Operation, Bee-Management and Bee-Health Indicators" were carried out.

Box 10: ISOOKO

ISOOKO was funded as an Innovation Action under ICT-39-2017. It runs from January 2018 to December 2020. It aims to support peace education through digital technologies. The ISOOKO project has three interrelated strands: ISOOKO as a Repository: How can (currently available or potential) digital technologies support and/or complement peace education?

ISOOKO as a Platform: How can we develop and trial a platform to support peace education, focusing on programmes and activities in Rwanda and Kenya

ISOOKO as a Process: How can we devise a methodology for developing and trialling such digital technologies more broadly?

Achievements to date

During the first year of the project, the baseline survey of digital technologies used in peace education in Rwanda has been undertaken. The participatory development methodology for ISOOKO has been drafted. Two weeks of in-country knowledge exchange workshops have been held in Rwanda, with schools and youth organisations. The initial wireframes for the ISOOKO platform have been developed. The ISOOKO project evaluation methodology has been drafted. The planning for the next round of in-country workshops in Rwanda and Kenya has been undertaken.

Table 6 below provides an overview of the project types, Horizon 2020 themes and partners from the 35 African countries currently participating in funded Horizon 2020 projects as at September 2018 (analysis undertaken by IST-Africa based on datasets published on Cordis as at September 2018).

Table 6: Horizon 2020 participation by African country (September 2018)

Country	Project Acronym / Project Type	Theme / Call / Partner
Angola	VirFree (MSCA-RISE)	MSCA-RISE-2016 (Instituto Superior Politecnico Do Kwanza Sul)
Algeria	RINEA (CSA)	H2020-INT-INCO-2014 (Ministere de L'enseignement Superieur et de la Recherche Scientifique)
	5TOI_4EWAS (CSA)	H2020-INT-INCO-2015 (Institut National de la Recherche Agronomique D Algerie; Agence Nationale de Valorisation des Resultats de la Recherche et du Developpement Technologique)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Ministere de L'enseignement Superieur et de la Recherche Scientifique)
	ODYSSEA (RIA)	H2020-BG-2016-2 (Sarl Nord Sud Ventures)
	EXANDAS (MSCA-RISE)	H2020-MSCA-RISE-2015 (Centre De Recherche Scientifique Et Technique En Analyses Physico-Chimiques)
	STUSOCSTA (MSCA-IF-GF)	H2020-MSCA-IF-2015 (UNIVERSITE D'ALGER 2)
	GHaNA (MSCA-RISE)	H2020-MSCA-RISE-2016 (Universite D Oran)
	Olive-Net (MSCA-RISE)	H2020-MSCA-RISE-2016 (Institut National de la Recherche Agronomique D Algerie)
	bTB-Test (MSCA-RISE)	H2020-MSCA-RISE-2017(Institut Pasteur D Algerie E.P.I.C.)
	LeiSHield-MATI (MSCA-RISE)	H2020-MSCA-RISE-2017 (Institut Pasteur D Algerie E.P.I.C.)
	PRE-LEAP-RE (CSA)	LC-SC3-JA-4-2018 (Ministere De L'enseignement Superieur Et De La Recherche Scientifique)
Benin	SaferAfrica (CSA)	H2020-MG-2016-SingleStage-RTD-MOVE (Abidjan Lagos Corridor Organisation for the Fight Against STIs HIV Aids)
	PEVIA (IMI2-RIA)	H2020-JTI-IMI2-2015-08-single-stage (Universite D Abomey Calavi Uac)

Country	Project Acronym / Project Type	Theme / Call / Partner
	GO-GA (IA)	H2020-ICT-2017-1 (Educational Technology And Research International Benin)
Botswana	PROIntensAfrica (CSA - Coordination & support action)	FOOD, H2020-SFS-2014-1 (Centre for Coordination of Agricultural Research and Development for Southern Africa)
	AfriAlliance (CSA - Coordination & support action)	H2020-WATER-2015 (Waternet Trust)
	IST-Africa 2016-2018 (CSA - Coordination & support action)	H2020-ICT-2016-INT (Ministry of Transport and Communications)
Burkina Faso	PROIntensAfrica (CSA)	H2020-SFS-2014-1 (Institut de L'environnement et de Recherches Agricoles)
	RINEA (CSA)	H2020-INT-INCO-2014 (Ministere de la Recherche Scientifique et de L'innovation)
	AfriAlliance (CSA)	H2020-WATER-2015-one-stage (Fondation 2ie Association)
	WAZIUP (RIA)	H2020-ICT-2015 (Universite Polytechnique de Bobo-Dioulasso)
	SaferAfrica (CSA)	H2020-MG-2016-SingleStage-RTD-MOVE (Initiatives Conseil International Sante)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Fonds National de la Recherche et de L'innovation pour le Developpement)
	INFRAVEC2 (RIA)	H2020-INFRAIA-2016-1 (Ministere de la Sante)
	Vaccinesurvey (MSCA-RISE)	H2020-MSCA-RISE-2014 (Ministere de la Sante)
	DEMOSTAF (MSCA-RISE)	H2020-MSCA-RISE-2015 (Universite de Ouagadougou, Institut National de la Statistique et de la Demographie)
	ANTHUSIA (MSCA-ITN-EJD)	H2020-MSCA-ITN-2017 (Institut des Sciences des Sociétés)
	EBOVAC2 (IMI2-RIA)	H2020-JTI-IMI2-2014-02-single-stage (Centre Muraz)
	LEAP4FNSSA (CSA)	SFS-33-2018 (Fonds National De La Recherche Et De L'innovation Pour Le Developpement)
	PRE-LEAP-RE (CSA)	LC-SC3-JA-4-2018 (Fondation 2ie Association)
Burundi	RINEA (CSA - Coordination & support action)	SOCIETY, H2020-INT-INCO-2014 (Ministere de L'Enseignement Superiet de la Recherche Scientifique)
	IST-Africa 2016-2018 (CSA - Coordination & support action)	H2020-ICT-2016-INT (Ministere de L'enseignement Superieur et de la Recherche Scientifique)
Cabo Verde	MARSU (MSCA-RISE)	H2020-MSCA-RISE-2015 (Instituto Nacional de Meteorologia E Geofisica)
	SALSA (RIA)	H2020-SFS-2015-2 (Universidade de Cabo Verde)

Country	Project Acronym / Project Type	Theme / Call / Partner
	SEACRIFOG (CSA)	H2020-INFRA-SUPP-2016-1 (Instituto Nacional de Desenvolvimento das Pescas)
	FarFish (RIA)	H2020-SFS-2016-2 (Instituto Nacional de Desenvolvimento Das Pescas)
	PADDLE (MSCA-RISE)	H2020-MSCA-RISE-2016 (Instituto Nacional de Desenvolvimento Das Pescas)
	CONCHA (MSCA-RISE)	H2020-MSCA-RISE-2017 (Instituto do Património Cultural)
	EMERTOX (MSCA-RISE)	H2020-MSCA-RISE-2017 (Universidade de Cabo Verde)
	RESISTANCE (MSCA-RISE)	H2020-MSCA-RISE-2017 (Universidade de Cabo Verde)
	AANCHOR (CSA)	BG-08-2018-2019 (Universidade de Cabo Verde)
Cameroon	DMC-MALVEC (RIA - Research and Innovation Action)	LEIT - ICT-39-2015 (Organisation de Coordination pour la Lutte Contre les Endémies en Afrique Centrale)
	OurMythicalChildhood (ERC-COG)	ERC-2015-CoG (Universite de Yaounde I)
	SaferAfrica (CSA)	H2020-MG-2016-SingleStage-RTD-MOVE (Ecole Nationale Supérieure des Travaux Publics)
	IST-Africa 2016-2018 (CSA - Coordination & support action)	H2020-ICT-2016-INT (Agence Nationale des Technologies de l'Information et de la Communication)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Ministry of Scientific Research and Innovation)
	BREEDCAFS (RIA)	H2020-SFS-2016-2 (Institut De Recherche Agricole pour le Developpement)
	SLAFNET (MSCA-RISE)	H2020-MSCA-RISE-2016 (Universite de Yaounde I)
Democratic Republic of Congo	ANTHUSIA (MSCA-ITN)	MSCA-ITN-2017 (Promundo-US)
Egypt	BEYOND (CSA - Coordination & support action)	LEIT-SPACE, H2020-Galileo-2014-1 (Arab Institute of Navigation)
	MERID (CSA - Coordination & support action)	SOCIETY, H2020-INT-INCO-2014 (Ministry of Higher Education and Scientific Research)
	Net4Mobility (CSA - Coordination & support action)	MSCA-SUPPORT, H2020-MSCA-NCP-2014 (Academy of Scientific Research and Technology ASRT)
	SiS.net2 (CSA - Coordination & support action)	Science with and for Society, H2020-GARRI-NCP-2014-1 (Academy of Scientific Research and Technology ASRT)
	VI-SEEM (RIA - Research and Innovation action)	INFRA, H2020-EINFRA-2015-1 (Bibliotheca Alexandrina Library of Alexandria Bibalex)

Country	Project Acronym / Project Type	Theme / Call / Partner
	GEO-CRADLE (CSA)	H2020-SC5-2015-one-stage (Centre for Environment and Development for the Arab Region and Europe)
	FEUTURE (RIA)	H2020-INT-SOCIETY-2015 (The American University in Cairo)
	MedReset (RIA)	H2020-INT-SOCIETY-2015 (Cairo University)
	IMAGE (RIA)	H2020-SFS-2015-2 (The Agricultural Research Center)
	WaterWorks2015 (ERA-NET-Cofund)	H2020-WATER-2015-one-stage (Academy of Scientific Research and Technology Asrt)
	SIMRA (RIA)	H2020-ISIB-2015-2 (Cairo University)
	MADFORWATER (RIA)	H2020-WATER-2015-two-stage (Ministry of Water Resources and Irrigation)
	5TOI_4EWAS (CSA)	H2020-INT-INCO-2015 (Academy of Scientific Research and Technology Asrt; National Research Center)
	4PRIMA (CSA)	H2020-SC5-2016-OneStageA (Ministry of Higher Education and Scientific Research)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Information Technology Industry Development Agency)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Ministry of Higher Education and Scientific Research)
	MedAID (RIA)	H2020-SFS-2016-2 (National Institute of Oceanography and Fisheries)
	CLUSDEV MED (MSCA-RISE)	H2020-MSCA-RISE-2014 (Academy of Scientific Research And Technology Asrt)
	ECOFISH (MSCA-RISE)	H2020-MSCA-RISE-2014 (The Agricultural Research Center and Kafr El-Sheikh University)
	NonMinimalHiggs (MSCA-RISE)	H2020-MSCA-RISE-2014 (Zewail City of Science & Technology)
	GLYCANC (MSCA-RISE)	H2020-MSCA-RISE-2014 (Cairo University)
	OptArch (MSCA-RISE)	H2020-MSCA-RISE-2015 (Cairo University)
	TACTILENet (MSCA-RISE)	H2020-MSCA-RISE-2015 (Nile University)
	trans-making (MSCA-RISE)	H2020-MSCA-RISE-2016 (Cairo Lab for Urban Studies Training & Environmental Research Cluster)
	ODYSSEA (RIA)	H2020-BG-2016-2 (Arab Network for Environment & Development)
	CURE-XF (MSCA-RISE)	H2020-MSCA-RISE-2016 (The Agricultural Research Center)

Country	Project Acronym / Project Type	Theme / Call / Partner
	ForestValue (ERA-NET-Cofund)	H2020-SFS-2017-1 (Academy of Scientific Research and Technology Asrt)
	WaterWorks2017 (ERA-NET-Cofund)	H2020-SC5-2017-OneStageB (Academy of Scientific Research and Technology Asrt)
	DiCoMI (MSCA-RISE)	H2020-MSCA-RISE-2017 (Central Metallurgical Research and Development Institute)
	Net4MobilityPlus (CSA)	H2020-MSCA-NCP-2017 (Academy of Scientific Research and Technology Asrt)
	NEXTFOOD (RIA)	H2020-RUR-2017-2 (Sekem Development Foundation - Sdf)
	HYDROUSA (IA)	H2020-CIRC-2017TwoStage (Heliopolis University Association and Isis For Food Industries, Ltd)
	InvisiblesPlus (MSCA-RISE)	H2020-MSCA-RISE-2015 (Zewail City of Science & Technology)
	LEAP4FNSSA (CSA)	H2020-SFS-2018-1 (Zewail City of Science & Technology)
Ethiopia	RINEA (CSA - Coordination & support action)	SOCIETY, H2020-INT-INCO-2014 (African Union)
	mHealth4Afrika (RIA - Research and Innovation Action)	LEIT - ICT-39-2015 (University of Gondar)
	DMC-MALVEC (RIA - Research and Innovation Action)	LEIT - ICT-39-2015
	its4land (RIA - Research and Innovation Action)	LEIT - ICT-39-2015 (Bahir Dar University)
	WATERSPOUTT (RIA)	H2020-WATER-2015-two-stage (Mekelle University)
	FLOWERED (RIA)	H2020-WATER-2015-two-stage (Addis Ababa University; Geomatrix Plc)
	BM (ERC-ADG)	ERC-2015-AdG (Addis Ababa University)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministry of Communication and Information Technology)
	EUROLEISH-NET (MSCA-ITN-ETN)	H2020-MSCA-ITN-2014 (University of Gondar)
	DiasporaLink(MSCA-RISE)	H2020-MSCA-RISE-2014 (Addis Ababa University)
	IMIXSED (MSCA-RISE)	H2020-MSCA-RISE-2014 (Jimma University)
	DAFNE (RIA)	H2020-WATER-2015-two-stage (Water and Land Resource Center)
	InnovAfrica (RIA)	H2020-SFS-2016-2 (Haramaya University)
	MUSA(RIA)	H2020-SFS-2016-2 (Southern Nations, Nationalities and Peoples Regional Agricultural Research Institute)

Country	Project Acronym / Project Type	Theme / Call / Partner
	SLAFNET (MSCA-RISE)	H2020-MSCA-RISE-2016 (Addis Ababa University)
	AfriCultuReS (RIA)	H2020-SFS-2017-1(Geosas Consulting Service Plc)
	BRTE(MSCA-RISE)	H2020-MSCA-RISE-2017 (Wolaita Sodo University)
	SAMS(IA)	H2020-ICT-2017-1 (Oromiya Agricultural Research Institute and Iceaddis It Consultancy Plc)
	NEXTFOOD (RIA)	H2020-RUR-2017-2 (Mekelle University)
	LEAP4FNSSA (CSA)	H2020-SFS-2018-1 (African Union)
Gabon	VSV-EBOPLUS (RIA)	IMI2-2015-08-01(Centre de Recherches Medicales de Lambaréné)
	VSV-EBOVAC (RIA)	IMI2-2014-02-01 (Centre de Recherches Medicales de Lambaréné)
Gambia	TILDA (RIA)	H2020-EU.3.4. (Office National D'etudes Et De Recherches Aerospatiales)
Ghana	TANDEM (CSA)	H2020-INFRA-SUPP-2014-2 (West and Central African Research and Education Network)
	Sci-GaIA (CSA)	H2020-INFRA-SUPP-2014-2 (West and Central African Research and Education Network)
	PROIntensAfrica (CSA)	H2020-SFS-2014-1 (Council for Scientific and Industrial Research, Forum for Agricultural Research in Africa, Ghana)
	MAGIC (MSCA-RISE)	H2020-MSCA-RISE-2014 (West and Central African Research and Education Network)
	AfriAlliance (CSA)	H2020-WATER-2015-one-stage (West African Science Service Center on Climate Change and Adapted Land Use, WASCAL)
	WAZIUP (RIA)	H2020-INT-INCO-2014 (Ispace Foundation; Farmerline Ltd)
	SMART (CSA)	H2020-TWINN-2015 (University of Ghana)
	SALSA (RIA)	H2020-SFS-2015-2 (University for Development Studies)
	Perform 2 scale (RIA)	H2020-SC1-2016-RTD (University of Ghana)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Council for Scientific and Industrial Research)

Country	Project Acronym / Project Type	Theme / Call / Partner
	SEACRIFOG (CSA)	H2020-INFRA-SUPP-2016-1 (West African Science Service Center on Climate Change and Adapted Land Use, WASCAL)
	TROPICSAFE (RIA)	H2020-SFS-2016-2 (Council for Scientific and Industrial Research)
	AfriCultuReS (RIA)	H2020-SFS-2017-1 (Centre for Remote Sensing and Geographic Information Services Lbg)
	TWIGA (RIA)	H2020-SC5-2017-OneStageB (Farmerline Ltd and Kwame Nkrumah University of Science and Technology Kumasi)
	WAZIHUB (IA)	H2020-ICT-2017-1 (ISpace Foundation and Kumasi Hive)
	LEAP4FNSSA (CSA)	SFS-33-2018 (Forum for Agricultural Research in Africa, Ghana))
	MIGNEX (RIA)	ENG-GLOBALLY-03-2017 (University of Ghana)
Kenya	AfricanBioServices (RIA - Research and Innovation action)	ENV, H2020-SC5-2014-two-stage (International Livestock Research Institute; Kenya Wildlife Service; Ministry of Environment and Mineral Resources)
	B3Africa (CSA - Coordination & support action)	INFRA, H2020-INFRA-SUPP-2014-2 (International Livestock Research Institute)
	COMRADES (RIA - Research and Innovation action)	LEIT-ICT, H2020-ICT-2015 (I-Hub Limited)
	ECOPOTENTIAL (RIA - Research and Innovation action)	ENV, H2020-SC5-2014-two-stage (United Nations Environment Programme)
	EMPOWER (RIA - Research and Innovation action)	TRANSPORT, H2020-MG-2014_TwoStages (United Nations Human Settlements Programme)
	EWIT (CSA - Coordination & support action)	ENV, H2020-WASTE-2014-one-stage (International Centre for Research In Sustainable Development Ent(ICRSD), Kisii County, Kisii University & Sellgelle International Consultancy Company Limited)
	REFRESH (RIA - Research and Innovation action)	ENV, H2020-WASTE-2014-two-stage (United Nations Environment Programme)
	TRUST (CSA - Coordination & support action)	Science with and for Society, H2020-GARRI-2014-1 (Partners for Health and Development in Africa (PHDA))
	mHealth4Afrika (RIA - Research and Innovation Action)	LEIT - ICT-39-2015 (Strathmore University)
	its4land (RIA - Research and Innovation Action)	LEIT - ICT-39-2015 (The Technical University of Kenya)
	SALSA (RIA)	H2020-SFS-2015-2 (African Centre for Technology Studies; International Centre for Research in Agroforestry)

Country	Project Acronym / Project Type	Theme / Call / Partner
	VicInAqua (RIA)	H2020-WATER-2015-two-stage (Ministry of Agriculture Livestock and Fisheries; Jomo Kenyatta University of Agriculture and Technology)
	RESCCUE (IA)	H2020-DRS-2015 (United Nations Human Settlements Programme)
	FLOWERED (RIA)	H2020-WATER-2015-two-stage (University of Eldoret)
	DAFNE (RIA)	H2020-WATER-2015-two-stage (African Collaborative Centre for Earth System Science (Access))
	Ground Truth 2.0 (IA)	H2020-SC5-2015-two-stage (Trans-African Hydro-Meteorological Observatory; Upande Limited)
	FUTURE-RADAR (CSA)	H2020-GV-2016-RTD (United Nations Human Settlements Programme)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministry of Education Science and Technology)
	UBORA (CSA)	H2020-INFRASUPP-2016-1 (Kenyatta University)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Ministry of Education Science and Technology)
	SEACRIFOG (CSA)	H2020-INFRASUPP-2016-1 (International Livestock Research Institute)
	VetBioNet (RIA)	H2020-INFRAIA-2016-1 (International Livestock Research Institute)
	TRUE (RIA)	H2020-SFS-2016-2 (Kenya Forestry Research Institute)
	INTERACT (ERC-STG)	ERC-2014-STG (Translators Without Borders)
	DEMOSTAF (MSCA-RISE)	H2020-MSCA-RISE-2015 (African Population & Health Research Centre Kenya)
	Tropical lichens (MSCA-IF-GF)	H2020-MSCA-IF-2015 (National Museums of Kenya)
	DIVERSify (RIA)	H2020-SFS-2016-2 (Kenya Forestry Research Institute)
	H2020 Insurance (IA)	H2020-SC5-2016-TwoStage (Trans-African Hydro-Meteorological Observatory)
	TICASS (MSCA-RISE)	H2020-MSCA-RISE-2016 (Pwani University College)
	InnovAfrica (RIA)	H2020-SFS-2016-2 (International Livestock Research Institute; Kenya Agricultural Research Institute and Kenya National Farmer's Federation)
	MUSA (RIA)	H2020-SFS-2016-2 (International Centre of Insect Physiology and Ecology Lbg and the Real Ipm Company (Kenya) Limited)
	PALE-Blu (RIA)	H2020-SFS-2016-2 (International Livestock Research Institute)

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	SLAFNET (MSCA-RISE)	H2020-MSCA-RISE-2016 (Catholic University of Eastern Africa and National Museums of Kenya)
	AfriCultuReS (RIA)	H2020-SFS-2017-1 (Locate It Limited)
	ANTHUSIA (MSCA-ITN-EJD)	H2020-MSCA-ITN-2017 (British Institute in Eastern Africa; Kenya Medical Research Institute and University of Nairobi)
	EPICA (IA)	H2020-ICT-2017-1 (African Virtual University and Maseno University)
	GO-GA (IA)	H2020-ICT-2017-1 (Elimu Elearning Company Limited)
	ISOOKO (IA)	H2020-ICT-2017-1 (Ushahidi Network)
	TWIGA (RIA)	H2020-SC5-2017-OneStageB (Strathmore University And Trans-African Hydro-Meteorological Observatory)
	InvECAT (CSA)	H2020-EE-2017-CSA-PPI (United Nations Environment Programme)
	WAZIHUB (IA)	H2020-ICT-2017-1 (Strathmore University)
	Circular Agronomics(RIA)	H2020-SFS-2017-2 (Eastern Africa Farmers' Federation Society)
	LEAP4FNSSA (CSA)	H2020-SFS-2018-1 (Network of African Science Academies (Nasac))
	PRE-LEAP-RE (CSA)	H2020-LC-SC3-2018-Joint-Actions-1 (Strathmore University)
Lesotho	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministry of Communications, Science and Technology)
Liberia	HOLISHIP (RIA)	H2020-MG-2015_TwoStages (Starbulk Sa)
Libyan Arab Jamahiriya	5TOI_4EWAS (CSA)	H2020-INT-INCO-2015 (University Engineering Consulting Office)
Madagascar	ARISE2 (RIA)	H2020-INFRADEV-1-2014-1 (University of Antananarivo)
	DEMOSTAF (MSCA-RISE)	H2020-MSCA-RISE-2015 (Institut National de la Statistique; Institut National de Sante Publique et Communautaire; Institut Pasteur de Madagascar; Universite Catholique de Madagascar)
	DySoMa (MSCA-IF-GF)	H2020-MSCA-IF-2015 (University of Antananarivo)
	CIRCASA (CSA)	H2020-SFS-2017-1 (University of Antananarivo)
Malawi	MAGIC (CSA - Coordination & support action)	INFRA, H2020-INFRA supp-2014-2 (UbuntuNet Alliance)
	Sci-GaIA (CSA - Coordination & support action)	INFRA, H2020-INFRA supp-2014-2 (UbuntuNet Alliance)
	TANDEM (CSA - Coordination & support action)	INFRA, H2020-INFRA supp-2014-2 (UbuntuNet Alliance)
	mHealth4Afrika (RIA - Research and Innovation Action)	LEIT - ICT-39-2015 (Chancellor College, University of Malawi)
	WATERSPOUTT (RIA)	H2020-WATER-2015-two-stage (University of Malawi)

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	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministry of Education, Science and Technology)
	Perform 2 scale (RIA)	H2020-SC1-2016-RTD (The Registered Trustees of the Research for Equity and Community Health Trust)
	SURG-Africa (RIA)	H2020-SC1-2016-RTD (University of Malawi)
	InnovAfrica (RIA)	H2020-SFS-2016-2 (Soils, Food And Healthy Communities(Sfhc) Limited and University of Malawi)
	ANTHUSIA (MSCA-ITN-EJD)	H2020-MSCA-ITN-2017 (University of Malawi)
Mali	WOSCAP (CSA)	H2020-BES-2014 (Universite des Sciences Juridiques et Politiques de Bamako)
	INFRAVEC2 (RIA)	H2020-INFRAIA-2016-1 (Universite des Sciences des Techniques et des Technologies de Bamako)
	DEMOSTAF (MSCA-RISE)	H2020-MSCA-RISE-2015 (Institut National de la Statistique)
	MOBILIMA (MSCA-IF-GF)	H2020-MSCA-IF-2016 (Point Sud)
Mauritius	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (National Computer Board)
	SLAFNET(MSCA-RISE)	H2020-MSCA-RISE-2016 (University of Mauritius)
Morocco	ORC-PLUS (IA)	H2020-LCE-2014-2 (Institut de Recherches en Energie Solaire et Energies Nouvelles)
	BEYOND (CSA)	H2020-Galileo-2014-1 (Centre Regional Africain des Sciences et Technologies de L'espace)
	MyOcean FO (CSA)	H2020-Adhoc-2014-20 (Institut National de Recherche Halieutique)
	RESLAG (IA)	H2020-WASTE-2014-two-stage (Moroccan Agency for Solar Energy Sa)
	MOSES (IA)	H2020-WATER-2014-two-stage (Universite Chouaib Doukkali)
	WASCOP (RIA)	H2020-LCE-2015-1-two-stage (Moroccan Agency for Solar Energy Sa)
	SOLPART (RIA)	H2020-LCE-2015-1-two-stage (Universite Cadi Ayyad)
	MedReset (RIA)	H2020-INT-SOCIETY-2015 (Universite Moulay Ismail)
	IMAGE (RIA)	H2020-SFS-2015-2 (Institut National de la Recherche Agronomique)
	MENARA (RIA)	H2020-INT-SOCIETY-2015 (Universite Al Akhawayn D'ifrane)
	MinWaterCSP (RIA)	H2020-LCE-2015-1-two-stage (Institut de Recherches en Energie Solaire et Energies Nouvelles)

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	RAISELIFE (IA)	H2020-NMP-2015-two-stage (Moroccan Foundation for Advanced Science Innovation and Researchfondation Mascir)
	MADFORWATER (RIA)	H2020-WATER-2015-two-stage (Institut Agronomique et Veterinaire Hassan li)
	5TOI_4EWAS (CSA)	H2020-INT-INCO-2015 (Association R&D MAROC; Ministere de L'enseignement Superieur, de la Recherche Scientifique et de la Formation des Cadres)
	4PRIMA (CSA)	H2020-SC5-2016-OneStageA (Ministere de L'enseignement Superieur, de la Recherche Scientifique et de la Formation Des Cadres)
	TARGET (CSA)	H2020-SwafS-2016-1 (Universite Hassan li de Casablanca)
	Geopark (MSCA-RISE)	H2020-MSCA-RISE-2014 (Universite Cadi Ayyad)
	BeFOre (MSCA-RISE)	H2020-MSCA-RISE-2014 (Institut National de la Recherche Agronomique)
	DiasporaLink (MSCA-RISE)	H2020-MSCA-RISE-2014 (Universite Al Akhawayn D'ifrane)
	TROPSense (MSCA-RISE)	H2020-MSCA-RISE-2014 (Universite Moulay Ismail)
	REC (MSCA-RISE)	H2020-MSCA-RISE-2014 (Universite Cadi Ayyad)
	CLUSDEV MED (MSCA-RISE)	H2020-MSCA-RISE-2014 (Universite Sidi Mohammed Ben Abdellah)
	NonMinimalHiggs (MSCA-RISE)	H2020-MSCA-RISE-2014 (Universite Abdelmalek Essaadi)
	SMART LOIRE VALLEY (MSCA-COFUND-FP)	H2020-MSCA-COFUND-2014 (Institut National de la Recherche Agronomique)
	MARSU (MSCA-RISE)	H2020-MSCA-RISE-2015 (Universite Mohammed V De Rabat)
	EXANDAS (MSCA-RISE)	H2020-MSCA-RISE-2015 (Universite Ibnou Zohr A Agadir)
	K.I.T.F.E.M. (MSCA-RISE)	H2020-MSCA-RISE-2016 (Universite Al Akhawayn D'ifrane)
	LungCARD (MSCA-RISE)	H2020-MSCA-RISE-2016 (Institut Pasteur du Maroc and Universite Hassan li de Casablanca)
	trans-making (MSCA-RISE)	H2020-MSCA-RISE-2016 (Association Racines)
	AMITIE (MSCA-RISE)	H2020-MSCA-RISE-2016 (Universite Mohammed V de Rabat)
	Olive-Net (MSCA-RISE)	H2020-MSCA-RISE-2016 (Ecole Nationale D'agriculture de Meknes)
	VAHVISTUS (MSCA-RISE)	H2020-MSCA-RISE-2016 (Ibn Tofail University)

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	FarFish (RIA)	H2020-SFS-2016-2 (Universite Cadi Ayyad)
	ODYSSEA (RIA)	H2020-BG-2016-2 (AGIR Association de Gestion Intégrée des Ressources)
	PALE-Blu (RIA)	H2020-SFS-2016-2 (Institut Agronomique Et Veterinaire Hassan li)
	TALK (MSCA-RISE)	H2020-MSCA-RISE-2016 (Fondation Cheikh Khalifa Ibn Zaid)
	CURE-XF (MSCA-RISE)	H2020-MSCA-RISE-2016 (Institut National de la Recherche Agronomique)
	INFINITE-CELL (MSCA-RISE)	H2020-MSCA-RISE-2017 (Moroccan Foundation for Advanced Science Innovation and Researchfondation Mascir and Universite Mohammed V de Rabat)
	CybSPEED (MSCA-RISE)	H2020-MSCA-RISE-2017 (Universite Hassan li de Casablanca)
	ENGIMA (MSCA-RISE)	H2020-MSCA-RISE-2017 (Universite Cadi Ayyad)
	STANDUP (MSCA-RISE)	H2020-MSCA-RISE-2017 (Universite Ibnou Zohr A Agadir)
	EMERTOX (MSCA-RISE)	H2020-MSCA-RISE-2017 (Universite Chouaib Doukkali)
	LeiSHield-MATI (MSCA-RISE)	H2020-MSCA-RISE-2017 (Institut Pasteur du Maroc)
	SUPER PV (IA)	H2020-LCE-2017-RES-IA (Moroccan Agency for Solar Energy Sa; Moroccan Foundation for Advanced Science Innovation and Researchfondation Mascir; Universite Mohammed V de Rabat)
	GREASE	ENG-GLOBALLY-01-2017 (Universite Mohammed V de Rabat)
Mozambique	EMI-TB (RIA - Research and Innovation action)	HEALTH, H2020-PHC-2014-single-stage (Instituto Nacional de Saúde)
	EHVA (RIA)	H2020-PHC-2015-single-stage_RTD (Instituto Nacional de Saúde)
	DAFNE (RIA)	H2020-WATER-2015-two-stage (Universidade Eduardo Mondlane)
	SafeWaterAfrica (RIA)	H2020-WATER-2015-two-stage (Salomon Lda)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Instituto Nacional de Tecnologias de Informação e Comunicação)
	FORAM (CSA)	H2020-SC5-2016-OneStageB (Gondwana Empreendimentos E Consultorias Limitada)
	AfriCultuReS (RIA)	H2020-SFS-2017-1 (Universidade Eduardo Mondlane)
	ANTHUSIA (MSCA-ITN-EJD)	H2020-MSCA-ITN-2017 (Universidade Eduardo Mondlane)
Namibia	RINEA (CSA - Coordination & support action)	SOCIETY, H2020-INT-INCO-2014 (Ministry of Education)

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	PARTY (MSCA-RISE)	H2020-MSCA-RISE-2014 (Polytechnic of Namibia Pon)
	HiTech AlkCarb (RIA)	H2020-SC5-2015-one-stage (Geo-Africa Prospecting Services Cc; A. Speiser-Environmental Consultants Cc)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministry of Education)
	SEACRIFOG (CSA)	H2020-INFRA-SUPP-2016-1 (Southern African Science Service Centre for Climate Change and Adaptive Land Management)
	ANTHUSIA (MSCA-ITN-EJD)	H2020-MSCA-ITN-2017 (Legal Assistance Centre)
	POEM (MSCA-ITN-ETN)	H2020-MSCA-ITN-2017 (Namibia University of Science And Technology)
Nigeria	RINEA (CSA)	H2020-INT-INCO-2014 (National Office for Technology Acquisition and Promotion Act)
	B3Africa (CSA)	H2020-INFRA-SUPP-2014-2 (Institute of Human Virology Nigeria Ltdgte)
	MycoKey (RIA)	H2020-SFS-2015-2 (International Institute of Tropical Agriculture)
	DiasporaLink (MSCA-RISE)	H2020-MSCA-RISE-2014 (Kwara State University)
	INTERWASTE (MSCA-RISE)	H2020-MSCA-RISE-2016 (University of Lagos-Unilag)
	LungCARD (MSCA-RISE)	H2020-MSCA-RISE-2016 (Federal University of Agriculture Abeokuta)
	MUSA (RIA)	H2020-SFS-2016-2 (International Institute of Tropical Agriculture)
	CIRCASA (CSA)	H2020-SFS-2017-1 (International Institute of Tropical Agriculture)
	GO-GA (IA)	H2020-ICT-2017-1 (Co-Creation Hub Limited)
	FANFAR (IA)	H2020-ICT-2017-1 (Nigeria Hydrological Services Agency)
	CRESTING (MSCA-ITN-ETN)	H2020-MSCA-ITN-2017 (University of Ibadan)
	LEAP4FNSSA (CSA)	SFS-33-2018 (International Institute of Tropical Agriculture)
Rwanda	its4land (RIA)	H2020-ICT-2015 (Esri Rwanda; Institut d'Enseignement Supérieur de Ruhengeri)
	InnovAfrica (RIA)	H2020-SFS-2016-2 (Rwanda Agriculture Board)
	AfriCultuReS (RIA)	H2020-SFS-2017-1 (University Of Rwanda)
	ISOOKO (IA)	H2020-ICT-2017-1 (Kigali Collaborative Research Center (Kcrc))
	PRE-LEAP-RE	LC-SC3-JA-4-2018 (Africa Energy Services Group Ltd)

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Senegal	MAGNIFIC (IA - Innovation action)	LEIT-SPACE, H2020-Galileo-2014-1 (Agence pour la Securite de la Navigation Aerienne en Afrique et a Madagascar)
	PROIntensAfrica (CSA - Coordination & support action)	FOOD, H2020-SFS-2014-1 (Conf. Respons. Recher. Agronom.Afriq. de L'Ouest & du Centre)
	REACTION (RIA - Research and Innovation action)	HEALTH, H2020-Adhoc-2014-20 (Universite Cheikh Anta Diop de Dakar)
	WAZIUP (RIA - Research and Innovation action)	LEIT - ICT-39-2015 (Uni of Gaston Bergeg de Saint Louis, CODER4Africa, CTIC Dakar)
	GRICAS (IA)	H2020-Galileo-2015-1 (Agence Pour la Securite de la Navigation Aerienne en Afrique et a Madagascar)
	EUNPACK (RIA)	H2020-INT-SOCIETY-2015 (Alliance pour Refonder la Gouvernance en Afrique Arga)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministere de la Recherche Scientifique)
	ZikaPLAN (RIA)	H2020-SC1-2016-RTD-Zika (Institut Pasteur de Dakar)
	ZIKAlliance (RIA)	H2020-SC1-2016-RTD-Zika (Institut Pasteur de Dakar)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Ministere de la Recherche Scientifique)
	INFRAVEC2 (RIA)	H2020-INFRAIA-2016-1 (Institut Pasteur de Dakar)
	EbolaMoDRAD (IMI2-RIA)	H2020-JTI-IMI2-2014-02-single-stage (Institut Pasteur de Dakar)
	DEMOSTAF (MSCA-RISE)	H2020-MSCA-RISE-2015 (Agence Nationale de la Statistique et de la Demographie; Universite Assane Seck de Ziguinchor; Universite Cheikh Anta Diop de Dakar)
	FarFish (RIA)	H2020-SFS-2016-2 (Conservation and Research of West African Aquatic Mammals (Corewam); Institut Senegalais de Recherches Agricoles)
	PALE-Blu (RIA)	H2020-SFS-2016-2 (Institut Senegalais de Recherches Agricoles)
	SLAFNET (MSCA-RISE)	H2020-MSCA-RISE-2016 (Universite Cheikh Anta Diop de Dakar)
	PADDLE (MSCA-RISE)	H2020-MSCA-RISE-2016 (Iucn - Senegal and Universite Cheikh Anta Diop De Dakar)
	GRIMASSE (IA)	H2020-GALILEO-GSA-2017-1 (Agence pour la Securite de la Navigation Aerienne en Afrique et a Madagascar)
	NADiRA (IA)	H2020-EO-2017 (Manobi Senegal - SA)

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	WAZIHUB (IA)	H2020-ICT-2017-1 (Sonatel - Sa; Universite Gaston Berger de Saint Louis)
	PRE-LEAP-RE (CSA)	LC-SC3-JA-4-2018 (Agence Nationale Pour Les Energies Renouvelables)
	LEAP4FNSSA (CSA)	SFS-33-2018 (Ministere de la Recherche Scientifique)
South Africa	AEROGUST (RIA) - Research and Innovation action)	TRANSPORT, H2020-MG-2014_TwoStages (University of Cape Town)
	B3Africa (CSA - Coordination & support action)	INFRA, H2020-INFRA-SUPP-2014-2 (Stellenbosch University & University of The Western Cape)
	BioMOre (RIA - Research and Innovation action)	ENV, H2020-SC5-2014-one-stage (MINTEK)
	ECOPOTENTIAL (RIA - Research and Innovation action)	ENV, H2020-SC5-2014-two-stage (Council for Scientific and Industrial Research)
	EUSPACE-AWE (CSA - Coordination & support action)	LEIT-SPACE, H2020-COMPET-2014 (National Research Foundation)
	EVAg (RIA - Research and Innovation action)	INFRA, H2020-INFRAIA-2014-2015 (Agricultural Research Council (ARC); National Health Laboratory Services)
	EWIT (CSA - Coordination & support action)	ENV, H2020-WASTE-2014-one-stage (Council for Scientific and Industrial Research, E-Waste Association of South Africa, Mintek & Pikitup Johannesburg (Proprietary) Limited, Choma Municipal Council)
	green.eu (CSA - Coordination & support action)	ENV, H2020-SC5-2014-one-stage (Stellenbosch University)
	GREEN-WIN (RIA - Research and Innovation action)	ENV, H2020-SC5-2014-two-stage (University of Cape Town)
	INTRAW (CSA - Coordination & support action)	ENV, H2020-SC5-2014-one-stage (Council for Scientific and Industrial Research)
	MAGIC (CSA - Coordination & support action)	INFRA, H2020-INFRA-SUPP-2014-2 (Council for Scientific and Industrial Research)
	nEUROSTRESSPEP (RIA - Research and Innovation action)	FOOD, H2020-SFS-2014-2 (University of Cape Town)
	NUCLEUS (CSA - Coordination & support action)	Science with and for Society, H2020-ISSI-2014-1 (National Research Foundation)
	PROIntensAfrica (CSA - Coordination & support action)	FOOD, H2020-SFS-2014-1 (Agricultural Research Council (ARC))
	RINEA (CSA - Coordination & support action)	SOCIETY, H2020-INT-INCO-2014 (Department of Science and Technology)

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	Sci-GaIA (CSA - Coordination & support action)	INFRA, H2020-INFRA-SUPP-2014-2 (Council for Scientific and Industrial Research)
	SEREN 3 (CSA - Coordination & support action)	SECURITY, H2020-DRS-2014 (Council for Scientific and Industrial Research)
	TBVAC2020 (RIA - Research and Innovation action)	HEALTH, H2020-PHC-2014-single-stage (Kwazulu Natal Research Institute for TB-HIV (K-RITH) NPC, Stellenbosch University & University of Cape Town)
	TRUST (CSA - Coordination & support action)	Science with and for Society, H2020-GARRI-2014-1 (The South African San Institute Trust, University of Cape Town & University of the Witwatersrand Johannesburg)
	VIROGENESIS (RIA - Research and Innovation action)	HEALTH, H2020-PHC-2014-two-stage (University of Kwazulu-Natal)
	WaterWorks2014 (ERA-NET-Cofund - ERA-NET Cofund)	ENV, H2020-WATER-2014-one-stage (Water Research Commission)
	AtlantOS (RIA - Research and Innovation action)	FOOD, H2020-BG-2014-2 (Council for Scientific and Industrial Research)
	SMART2D (RIA - Research and Innovation action)	HEALTH, H2020-HCO-2014 (University of The Western Cape)
	mHealth4Afrika (RIA - Research and Innovation Action)	LEIT - ICT-39-2015 (Nelson Mandela Metropolitan University)
		H2020-WATER-2015-one-stage (Iclei - Local Governments for Sustainability - Africa; Water Research Commission; Council for Scientific and Industrial Research)
	AfriAlliance (CSA)	
	IN-SKA (RIA)	H2020-INFRADEV-1-2015-1 (National Research Foundation)
	INTMET (RIA)	H2020-SC5-2015-one-stage (Mintek)
	GLOBUS (RIA)	H2020-INT-SOCIETY-2015 (University of the Witwatersrand Johannesburg)
	M-ERA.NET 2 (ERA-NET-Cofund)	H2020-NMP-ERA-NET-2015 (Department of Science and Technology)
	STRADE (CSA)	H2020-SC5-2015-one-stage (University of the Witwatersrand Johannesburg; Dmt-Kai Batla Pty Ltd)
	WaterWorks2015 (ERA-NET-Cofund)	ERA-NET-Cofund (Water Research Commission)
	MinWaterCSP (RIA)	H2020-LCE-2015-1-two-stage (Notus Fan Engineering; Stellenbosch University; Kelvion Thermal Solutions (Pty) Ltd)
	FERTINNOWA (CSA)	H2020-WATER-2015-one-stage (Optima Agrik Pty Ltd)
	ICRI 2016 (CSA)	H2020-Adhoc-2014-20 (Department of Science and Technology)

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	FutureTrust (IA)	H2020-DS-2015-1 (Law Trusted Third Party Services Pty Ltd)
	WATERSPOUTT (RIA)	H2020-WATER-2015-two-stage (Stellenbosch University)
	caLIBRAte (RIA)	H2020-NMP-2015-two-stage (National Health Laboratory Services)
	SafeWaterAfrica (RIA)	H2020-WATER-2015-two-stage (Tshwane University of Technology; Council for Scientific and Industrial Research; Advance Call Pty Ltd; Virtual Consulting Engineers Vce; Stellenbosch University)
	ESASTAP 2020 (CSA)	H2020-INT-INCO-2015 (Academy of Science of South Africa; National Research Foundation; Technology Innovation Agency; Department of Science and Technology)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Department of Science and Technology)
	MarTERA (ERA-NET-Cofund)	H2020-BG-2016-1 (Department of Science and Technology)
	COP21 RIPPLES (RIA)	H2020-SC5-2016-OneStageB (University of Cape Town)
	ERA-MIN 2 (ERA-NET-Cofund)	H2020-SC5-2016-OneStageB (Department of Science and Technology)
	AENEAS (RIA)	H2020-INFRA supp-2016-1 (Council for Scientific and Industrial Research; University of Cape Town; National Research Foundation)
	JUMPING JIVE (CSA)	H2020-INFRADEV-2016-1 (Department of Science and Technology)
	SPICES (RIA)	H2020-SC1-2016-RTD (University of Limpopo)
	anTBiotic (RIA)	H2020-SC1-2016-RTD (Task Foundation Npc; University of Cape Town)
	RadioNet (RIA)	H2020-INFRAIA-2016-1 (Department of Science and Technology)
	RINGO (CSA)	H2020-INFRADEV-2016-1 (University of the Witwatersrand Johannesburg)
	4D hybrid (RIA)	H2020-FOF-2016 (Council for Scientific and Industrial Research)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (National Research Foundation; Department of Science and Technology)
	SEACRIFOG (CSA)	H2020-INFRA supp-2016-1 (University of the Witwatersrand Johannesburg; National Research Foundation)
	ITERAMS (RIA)	H2020-SC5-2016-OneStageB (University of Cape Town)
	SIENNA (CSA)	H2020-SwafS-2016-1 (University of Cape Town)

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	TROPICSAFE (RIA)	H2020-SFS-2016-2 (Patho Solutions (Pty) Ltd; Vinpro; Stellenbosch University; University of Pretoria)
	CREATE-Net (MSCA-RISE)	H2020-MSCA-RISE-2014 (Council for Scientific And Industrial Research)
	EVE (MSCA-RISE)	H2020-MSCA-RISE-2014 (Armaments Corporation of South Africa; Esteq Engineering (Pty) Ltd; University of Pretoria)
	GreenBubbles (MSCA-RISE)	H2020-MSCA-RISE-2014 (Noordwes-Universiteit; Divers Alert Network Southern Africa)
	MAT4TREAT (MSCA-RISE)	H2020-MSCA-RISE-2014 (Stellenbosch University)
	SAF21 (MSCA-ITN-ETN)	H2020-MSCA-ITN-2014 (South African Association for Marine Biological Research)
	Sustain-Owner (MSCA-RISE)	H2020-MSCA-RISE-2014 (University of Pretoria)
	PARTY (MSCA-RISE)	H2020-MSCA-RISE-2014 (Cape Peninsula University of Technology; The South African Institute of Technology)
	FlyHigh (MSCA-RISE)	H2020-MSCA-RISE-2014 (Agri Protein Technologies (Pty) Ltd)
	WORMTUMORS (MSCA-IF-GF)	H2020-MSCA-IF-2014 (University of Cape Town)
	Ocean Medicines (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of the Western Cape)
	FAB-MOVE (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of the Western Cape)
	MediHealth (MSCA-RISE)	H2020-MSCA-RISE-2015 (Tshwane University of Technology)
	MIREL (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of Cape Town)
	PEARL (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of Johannesburg)
	RUBICON (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of Cape Town)
	SOLIRING (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of Cape Town)
	NEARCONTROL (MSCA-IF-GF)	H2020-MSCA-IF-2014 (University of Kwazulu-Natal)
	Muscle stress relief (MSCA-RISE)	H2020-MSCA-RISE-2014 (Stellenbosch University)
	SYSMICS (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of the Witwatersrand Johannesburg)
	GEMCLIME (MSCA-RISE)	H2020-MSCA-RISE-2015 (University of Cape Town)
	TECH4EFFECT (BBI-RIA)	H2020-BBI-PPP-2015-2-1 (Stellenbosch University)
	BioCapture (MSCA-ITN-ETN)	H2020-MSCA-ITN-2016 (ReSyn Biosciences)

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	CyanoAlert (IA)	H2020-EO-2016 (Cyanolakes (Pty) Ltd)
	INTERWASTE (MSCA-RISE)	H2020-Msca-Rise-2016 (Tshwane University of Technology; University of Kwazulu-Natal)
	VirFree (MSCA-RISE)	H2020-MSCA-RISE-2016 (University of Pretoria)
	WIRL (MSCA-COFUND-FP)	H2020-MSCA-COFUND-2015 (African Arts Institute)
	CID (MSCA-RISE)	H2020-MSCA-RISE-2016 (University of South Africa)
	SPARK (MSCA-COFUND-DP)	H2020-MSCA-COFUND-2016 (South African Institute for Aquatic Biodiversity)
	TICASS (MSCA-RISE)	H2020-MSCA-RISE-2016 (University of the Witwatersrand Johannesburg)
	Honeyguides-Humans (ERC-COG)	ERC-2016-COG (University of Cape Town)
	InnovAfrica (RIA)	H2020-SFS-2016-2 (Agricultural Research Council (ARC))
	AfriCultuReS (RIA)	H2020-SFS-2017-1 (South Africa National Space Agency)
	CIRCASA (CSA)	H2020-SFS-2017-1 (Agricultural Research Council (ARC))
	INFACT (RIA)	H2020-SC5-2017-OneStageB (GALSA (PTY) LTD)
	INFINITE-CELL (MSCA-RISE)	H2020-MSCA-RISE-2017 (University of the Western Cape)
	TechTIDE (RIA)	H2020-COMPET-2017 (South Africa National Space Agency)
	HYDRIDE4MOBILITY (MSCA-RISE)	H2020-MSCA-RISE-2017 (TR Design; University of the Western Cape; Impala Platinum)
	ThermaSMART (MSCA-RISE)	H2020-Msca-Rise-2017 (University of Pretoria)
	ANTHUSIA (MSCA-ITN-EJD)	H2020-MSCA-ITN-2017 (Abahlali baseMjondolo Movement; Centre for Development and Enterprise; Southern Africa Labour and Development Unity; Wits School of Governance)
	BIODEST (MSCA-RISE)	H2020-MSCA-RISE-2017 (Stellenbosch University)
	CARE4C (MSCA-RISE)	H2020-MSCA-RISE-2017 (Merensky Timber (Pty) Ltd; Stellenbosch University)
	RISE (RIA)	H2020-SC1-2017-Single-Stage-RTD (University of Cape Town)
	WaterWorks2017 (ERA-NET-Cofund)	H2020-SC5-2017-OneStageB (Water Research Commission)
	TWIGA (RIA)	H2020-SC5-2017-OneStageB (South African Weather Service)
	DiCoMI (MSCA-RISE)	H2020-MSCA-RISE-2017 (Vaal University of Technology)

Country	Project Acronym / Project Type	Theme / Call / Partner
	CatChain (MSCA-RISE)	H2020-MSCA-RISE-2017 (Tshwane University of Technology)
	CO-CREATE (RIA)	H2020-SFS-2017-2 (University of Cape Town)
	RRING (RIA)	H2020-SwafS-2017-1 (National Research Foundation)
	SEREN 4 (CSA)	H2020-SEC-2016-2017-2 (Council for Scientific and Industrial Research)
	WAZIHUB (IA)	H2020-ICT-2017-1 (Makers Be Like)
	DEFEND (RIA)	H2020-SFS-2017-2 (Agricultural Research Council (Arc); University of Pretoria)
	PACIFIC (RIA)	H2020-SC5-2017-OneStageB (Institute of Mine Seismology (PTY)LTD)
	Group-Dynamics-TCB (ERC-ADG)	ERC-2016-ADG (Kalahari Research Trust)
	HOMED (RIA)	H2020-SFS-2017-2 (University of Pretoria)
	AANChOR (CSA)	H2020-BG-2018-1 (National Research Foundation, Council for Scientific and Industrial Research, Department of Science And Technology)
	AIMS-2-TRIALS (IMI2-RIA)	H2020-JTI-IMI2-2016-10-two-stage (Stellenbosch University)
	DAFNE (RIA)	H2020-WATER-2015-two-stage (University Of Zambia)
	DMC-MALVEC (RIA)	H2020-ICT-2015 (Ministry of Health)
	Ground Truth 2.0 (IA)	H2020-SC5-2015-two-stage (World Wide Fund for Nature (WWF) Zambia)
	LEAP4FNSSA (CSA)	H2020-SFS-2018-1 (National Research Foundation, Agricultural Research Council (Arc), Department of Science and Technology)
	MicrobiomeSupport (CSA)	H2020-SFS-2018-1 (University of Pretoria)
	PRE-LEAP-RE (CSA)	H2020-LC-SC3-2018-Joint-Actions-1 (National Research Foundation, Department of Science And Technology)
	PreMa (IA)	H2020-NMBP-SPIRE-2018 (Stellenbosch University, Mintek, Transalloys Pty Ltd)
	RESIST (MSCA-RISE)	H2020-MSCA-RISE-2018 (University of Cape Town)
	ReTraCE (MSCA-ITN-ETN)	H2020-MSCA-ITN-2018 (African Circular Economy Network)
	SURG-Africa (RIA)	H2020-SC1-2016-RTD (The Surgical Society of Zambia)
	SUSTINNO (MSCA-IF-GF)	H2020-MSCA-IF-2017 (University of Cape Town)

Country	Project Acronym / Project Type	Theme / Call / Partner
Swaziland	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministry of Information Communications & Technology)
Tanzania	AfricanBioServices (RIA - Research and Innovation action)	ENV, H2020-SC5-2014-two-stage (Sokoine University of Agriculture, Tanzania Wildlife Research Institute; University of Dodoma; University of Dar Es Salaam)
	Sci-GaIA (CSA - Coordination & support action)	INFRA, H2020-INFRA-SUPP-2014-2 (Dar es Salaam Institute of Technology)
	EHVA (RIA)	H2020-PHC-2015-single-stage_RTD (National Institute for Medical Research)
	VicInAqua (RIA)	H2020-WATER-2015-two-stage (Science, Technology and Innovation Policy Research Organisation)
	FLOWERED (RIA)	H2020-WATER-2015-two-stage (Oikos East Africa; The Nelson Mandela African Institute of Science and Technology)
	IST Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Tanzania Commission for Science and Technology)
	SURG-Africa (RIA)	H2020-SC1-2016-RTD (East Central and Southern Africa Health Community)
	IMIXSED (MSCA-RISE)	H2020-MSCA-RISE-2014 (The Nelson Mandela African Institute of Science and Technology)
	ACTUS (MSCA-IF-GF)	H2020-MSCA-IF-2014 (Ardhi University)
	InnovAfrica (RIA)	H2020-SFS-2016-2 (Sokoine University of Agriculture)
	PEVIA (IMI2-RIA)	H2020-JTI-IMI2-2015-08-single-stage (Ifakara Health Institute Trust)
	PITBUL (RIA)	H2020-NMBP-X-KET-2017 (Dodoma Region)
	ANTHUSIA (MSCA-ITN-EJD)	H2020-MSCA-ITN-2017 (National Institute of Medical Research)
	EPICA (IA)	H2020-ICT-2017-1 (The Open University of Tanzania)
	UPSIDES (RIA)	H2020-SC1-2017-Single-Stage-RTD (Ifakara Health Institute Trust)
	MONOCLE (RIA)	H2020-SC5-2017-OneStageB (Tanzania Fisheries Research Institute)
	WAZIHUB (IA)	H2020-ICT-2017-1 (Dar Teknohama Business Incubator Limited)
Togo	MAGNIFIC (BBI-RIA)	H2020-BBI-JTI-2016 (Universite de Lome)
	EdiCitNet (IA)	H2020-SCC-NBS-2stage-2017 (Ville de Lome)

Country	Project Acronym / Project Type	Theme / Call / Partner
Tunisia	ARISE2 (RIA - Research and Innovation action)	INFRA, H2020-INFRADEV-1-2014-1 (Centre National de la Cartographie et de la Teledetection)
	GEO-CRADLE (CSA)	H2020-SC5-2015-one-stage (Centre D'etudes et de Recherches de telecommunications)
	MedReset (RIA)	H2020-INT-SOCIETY-2015 (Faculte de Droit et des Sciences Politiques de Tunis)
	WaterWorks2015 (ERA-NET-Cofund)	H2020-WATER-2015-one-stage (Institution de la Recherche et de L'enseignement Superieur Agricoles)
	SALSA (RIA)	H2020-SFS-2015-2 (Institut National de la Recherche Agronomique de Tunisie)
	MIDES (IA)	H2020-NMP-2015-two-stage (Ecole Nationale D'ingenieurs de Gabes)
	MADFORWATER (RIA)	H2020-WATER-2015-two-stage (Faculty of Sciences of Tunis, University of Tunis el Manar; Institut Superieur de Biotechnologie de Sidi Thabet)
	FLOWERED (RIA)	H2020-WATER-2015-two-stage (Observatoire du Sahara et du Sahel)
	5TOI_4EWAS (CSA)	H2020-INT-INCO-2015 (Chambre de Commerce et D Industrie du Centre; Ministry of Higher Education and Scientific Research; Agence Nationale de Protection de L'environnement)
	4PRIMA (CSA)	H2020-SC5-2016-OneStageA (Ministry of Higher Education and Scientific Research)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Ministry of Higher Education and Scientific Research)
	trans-making (MSCA-RISE)	H2020-MSCA-RISE-2016 (Forum Tunisien pour les Droits Economiques et Sociaux)
	IPM-4-Citrus (MSCA-RISE)	H2020-MSCA-RISE-2016 (Centre de Biotechnologie de Sfax - Cbs; Institut Pasteur de Tunis; Centre Technique des Agrumes; Wiki Start-Up; Les Laboratoires Medis)
	DARE (RIA)	H2020-SC6-REV-INEQUAL-2016 (Sfax University)
	MedAID (RIA)	H2020-SFS-2016-2 (Institut National des Sciences et Technologies de la Mer)
	InSPIRES (RIA)	H2020-SwafS-2016-1 (Institut Pasteur de Tunis)
	ODYSSEA (RIA)	H2020-BG-2016-2 – (Association Nationale de Développement Durable et de la Conservation de la Vie Sauvage)
	H2020 WP2017-2018	H2020 WP2017-2018 (CSA) - (Agence de Promotion de l'Industrie et de l'Innovation)

Country	Project Acronym / Project Type	Theme / Call / Partner
	PALE -BLU (RIA)	H2020-SFS-2016-2 - (Institut Pasteur de Tunis)
	PRACTICES (RIA)	H2020-SEC-2016-2017-1 - (Associatio Forum des Sciences Sociales Appliquées ; Présidence du Gouvernement)
	CURE-XF (MSCA-RISE)	H2020-MSCA-RISE-2016 - (Institut National de la Recherche Agronomique de Tunisie)
	EUROLEISH-NET (MSCA-ITN-ETN)	H2020-MSCA-ITN-2014 (Institut Pasteur de Tunis)
	TROPSENSE (MSCA-RISE)	H2020-MSCA-RISE-2014 (Institut Pasteur de Tunis)
	MediHealth (MSCA-RISE)	H2020-MSCA-RISE-2015 (Faculte des Sciences de Sfax)
	EXANDAS (MSCA-RISE)	H2020-MSCA-RISE-2015 (Centre De Biotechnologie De Sfax - Cbs)
	ForestValue (ERA-NET-Cofund)	H2020-SFS-2017-1 (Institution de la Recherche et de L'enseignement Superieur Agricoles)
	BITRECS (MSCA-COFUND-FP)	H2020-MSCA-COFUND-2016 (Institut Pasteur de Tunis)
	AfriCultuReS (RIA)	H2020-SFS-2017-1 (Observatoire du Sahara et du Sahel)
	CLAIM (IA)	H2020-BG-2017-1 (Institut National des Sciences et Technologies de la Mer)
	INCREdible (CSA)	H2020-RUR-2017-1 (Institut National de Recherches en Genie Rural, Eaux et Forets)
	bTB-Test (MSCA-RISE)	H2020-MSCA-RISE-2017 (Institut Pasteur de Tunis)
	WaterWorks2017 (ERA-NET-Cofund)	H2020-SC5-2017-OneStageB (Institution de la Recherche et de L'enseignement Superieur Agricoles; Ministry of Higher Education and Scientific Research)
	EMERTOX (MSCA-RISE)	H2020-MSCA-RISE-2017 (Institut National des Sciences et Technologies de la Mer)
	LeiSHield-MATI (MSCA-RISE)	H2020-MSCA-RISE-2017 (Institut Pasteur de Tunis)
	BRESOV (RIA)	H2020-SFS-2017-2 (Universite de Tunis el Manar)
	LIVERUR (RIA)	H2020-RUR-2017-2 (Dar Margoum Ouedhref)
	R-I PEERS (CSA)	H2020-SwafS-2017-1 (Agence Nationale de la Promotion de la Recherche Scientifique)
	SECREDAS (ECSEL-RIA)	H2020-ECSEL-2017-2-RIA-two-stage (Ecole Nationale D'ingenieurs de Tunis; Ecole Superieure des Communications de Tunis)
	SUPER PV (IA)	H2020-LCE-2017-RES-IA (Agence Nationale pour la Maitrise de L'energie)

Country	Project Acronym / Project Type	Theme / Call / Partner
	EdiCitNet (IA)	H2020-SCC-NBS-2stage-2017 (Association Tunisienne de Developpement Durable: la Recherche en Action; Commune de Carthage)
	PHINDaccess (CSA)	H2020-WIDESPREAD-05-2017-Twinning (Institut Pasteur de Tunis)
	FASTER (CSA)	H2020-WIDESPREAD-05-2017-Twinning (Institution de la Recharge et de l'enseignement Superieur Agricoles, Institut National de Recherches en Genie Rural, Eaux et Forets, Agence de Vulgarisation et de la Formation Agricoles)
	S4Pro (RIA)	H2020-SPACE-2018 (Ecole Nationale d'Ingenieurs de Gabes)
Uganda	B3Africa (CSA - Coordination & support action)	INFRA, H2020-INFRA-SUPP-2014-2 (Makerere University)
	FRESH AIR (RIA - Research and Innovation action)	HEALTH, H2020-HCO-2015 (Makerere University)
	PROIntensAfrica (CSA - Coordination & support action)	FOOD, H2020-SFS-2014-1 (African forum for Agricultural Advisory Services & The Registered Trustees of the Association for Strengthening Agricultural Research in Eastern and Central Africa)
	PROTEIN2FOOD (RIA - Research and Innovation action)	FOOD, H2020-SFS-2014-2 (Makerere University)
	SMART2D (RIA - Research and Innovation action)	HEALTH, H2020-HCO-2014 (Makerere University)
	EHVA (RIA)	H2020-PHC-2015-single-stage_RTD (Uganda National Health Research Organisation)
	VicInAqua (RIA)	H2020-WATER-2015-two-stage (National Agricultural Research Organisation)
	BigPicnic (CSA)	H2020-ISSI-2015-1 (Tooro Botanical Gardens)
	WATERSPOUTT (RIA)	H2020-WATER-2015-two-stage (Makerere University)
	IST-Africa 2016-2018 (CSA)	H2020-ICT-2016-INT (Uganda National Council for Science and Technology)
	UBORA (CSA)	H2020-INFRA-SUPP-2016-1 (Uganda Industrial Research Institute)
	SPICES (RIA)	H2020-SC1-2016-RTD (Makerere University)
	Perform 2 scale (RIA)	H2020-SC1-2016-RTD (Makerere University)
	LEAP-AGRI (ERA-NET-Cofund)	H2020-SFS-2016-1 (Uganda National Council for Science and Technology)
	CHIBOW (MSCA-ITN-ETN)	H2020-MSCA-ITN-2014 (Facilitation for Peace and Development; All Saints University Lira)

Country	Project Acronym / Project Type	Theme / Call / Partner
	PROIntensAfrica (CSA)	H2020-SFS-2014-1 (African Forum for Agricultural Advisory Services; The Registered Trustees of The Association for Strengthening Agricultural Research in Eastern and Central Africa)
	DEMOSTAF (MSCA-RISE)	H2020-MSCA-RISE-2015 (Makerere University)
	SYBAWHEY (MSCA-RISE)	H2020-MSCA-RISE-2015 (Afribanana Products Limited; Kyambogo University)
	EPICA (IA)	H2020-ICT-2017-1 (Makerere University)
	ISOOKO (IA)	H2020-ICT-2017-1 (Makerere University)
	UPSIDES (RIA)	H2020-SC1-2017-Single-Stage-RTD (Butabika National Mental Hospital)
	TWIGA (RIA)	H2020-SC5-2017-OneStageB (Makerere University)
	WAZIHUB (IA)	H2020-ICT-2017-1 (Hive Colab; Women in Technology Uganda)
	LEAP4FNSSA (CSA)	H2020-SFS-2018-1 (Regional Universities Forum for Capacity Building in Agriculture Limited (forum) by guarantee, The Registered Trustees of the Association for Strengthening agricultural research in Eastern and Central Africa)
Zambia	EWIT (CSA)	H2020-WASTE-2014-one-stage (Choma Municipal Council)
	DMC-MALVEC (RIA)	H2020-ICT-2015 (Ministry of Health)
	DAFNE (RIA)	H2020-WATER-2015-two-stage (University of Zambia)
	Ground Truth 2.0 (IA)	H2020-SC5-2015-two-stage (World Wide Fund for Nature (Wwf) Zambia)
	SURG-Africa (RIA)	H2020-SC1-2016-RTD (The Surgical Society of Zambia)



The **European Development Fund (EDF)** supports the implementation of the European Union's (EU's) Cotonou Partnership Agreement and is the main instrument for providing support to African, Caribbean and Pacific (ACP) countries. It also provides funding for the EU's Overseas Countries and Territories. The EDF has a strong poverty focus and 85% of funds go to Low Income Countries. Since 2000, the Cotonou Agreement has governed relations between the 78 ACP countries and the 28 EU Member States. The EDF began in 1959 and is now in its 11th cycle (2014-2020).

**European
Development
Funds - EDF11
NIP
encouraging
exploiting ICT**

It is positive that the National Indicative Programmes for EDF11 incorporate "**exploiting the potential of Information and Communication Technologies**" as one of the cross-cutting factors to be considered in the focal sectors, when designing sector interventions. It is clear that ICT has a critical role to play as a horizontal enabler in Education, Health, Rural Development, Agriculture, Water and Transport related activities both at national and cross-border level. Africa continues to demonstrate leadership in innovative exploitation of mobile technologies and applications - it is important that this expertise is leveraged when developing sectoral applications.

While the importance of appropriately leveraging ICT has been recognised in the Millennium Development Goals (MDGs) and in the National Indicative Programme for EDF 11, it is reinforced again as a valuable horizontal enabler in the Sustainable Development Goals (SDGs)⁶. SDG9 focuses on building resilient infrastructure, promoting inclusive and sustainable industrialisation and fostering innovation. The appropriate use of ICT is also highlighted within SDG3 Health, SDG4 Education, SDG5 Gender Equality, SDG6 Water and Sanitation, SDG7 Energy, SDG11 Sustainable Cities and Communities and SDG13 Climate Change. In the context of EDF10 and EDF 11 a lot of investment has been put into infrastructure and digitisation is being actively encouraged.

As part of the planning to support the Sustainable Development Goals, over the past number of years there has been a move towards developing Digital Development Strategies - for example: Belgium, Estonia, France, Germany, United Kingdom, Finland, Netherlands, Sweden, World Bank.

Following the publication by the World Bank of "Digital Dividends", the 2016 World Development Report, the World Bank Digital Development Partnership was established in 2016 to assist low and middle-income countries to benefit from the digital age. It has six main priority areas: Data and Indicators, Digital Economy, Enabling Environment, Cybersecurity, Internet Access for All, Digital Government, and Mainstreaming Digital Solutions.

⁶ <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

Digital4Development

Within this overall context of a changing response to development, the European Commission developed the Digital4Development⁷ framework to *"mainstream digital technologies across four main priority areas:*

- i) promote access to affordable and secure broadband connectivity and to digital infrastructure, including the necessary regulatory reforms;*
- ii) promote digital literacy and skills;*
- iii) foster digital entrepreneurship and job creation; and*
- iv) promote the use of digital technologies as an enabler for sustainable development."*

The Commission Staff Working Document *"Digital4Development: mainstreaming digital technologies and services into EU Development Policy"* SWD(2017) 157 final was published in May 2017. It was presented during IST-Africa 2017 in Namibia.

It aims to provide a framework to *"promote information and communication technologies in developing countries as powerful enablers of growth, and to better mainstream digital solutions in development"*. It builds on previous investments in infrastructure networks, policy harmonisation, digital technology projects and cyber resilience. During the initial phase it is primarily focused on Africa.

In a developing country context, barriers that are highlighted in the context of the four priority areas include: cost of broadband access, digital literacy skills, local content, regulatory barriers, low public sector support for local products and services, need for entrepreneurial skills, need to develop and implement cybersecurity policies and encourage open access to relevant data sets.

In the context of priority area four "Digital technologies as an enabler", seven areas have been identified: Digital 4 Gender Equality; Digital 4 Climate Change, Environment and Sustainable Energy; Digital 4 Secure Identity for all; Digital 4 Capacity Building; Digital 4 Sustainable Agriculture; Digital 4 Education and Human Development and Digital 4 Health.

While Digital4Development provides a framework, it does not have a dedicated budget or funding instrument. It is envisaged that projects and initiatives launched will leverage existing funding mechanisms such as European Development Funds (National and/or Regional Indicative Programmes), Horizon 2020, Erasmus+, Development Cooperation Instrument. It is important that there is ongoing engagement with EU Member States, partner countries, academia, civil society and digital private sector to ensure successful implementation.

Short term actions

To kick-start this framework a number of actions were identified to commence during 2017 / 2018 using existing funding mechanisms (Annex 1 of Working Document). Box 11 below provides an overview of

⁷ https://ec.europa.eu/europeaid/sites/devco/files/swd-digital4development_part1_v3.pdf

the short-term actions that have commenced focused on Africa. Boxes 12 - 15 provide insight into the objectives and current status for Central African Republic component of the Central Africa Backbone Project, Cyber4D, PRIDA and Digital4Inclusion.

Box 11: Digital 4 Development - Short term actions

Commission Staff Working Document "Digital4Development: mainstreaming digital technologies and services into EU Development Policy" SWD(2017) 157 final identified five projects focused on Africa to commence during 2017/2018 using existing funding mechanisms:

Multinational Trans-Saharan Backbone (TSB) Optical Fiber Project (TSB) - Niger and Chad, EU Contribution: €29 million, Funding Instruments: AfIF, PANAF/DCI (BUDGET), funds Blending / Lead financier: AfDB

Central Africa Backbone (CAB) Project – Central African Republic (CAR) Component, Cameroon, DRC and CAR, EU Contribution: €17.5 million, Funding Instruments: RIP Central Africa (EDF) through AfIF, Blending / Lead Financier: AfDB

Cyber Resilience for Development - Cyber4D, initially focused on Botswana and Mauritius, EU Contribution: €11 million, Funding instrument: Instrument contributing to Stability and Peace (IcSP) (BUDGET)

Policy and Regulation Initiative for Digital Africa (PRIDA), EU Contribution: €7.5 million, Funding instrument: PANAF/DCI (BUDGET)

"Digital4Inclusion": Support to financial inclusion in ACP countries through the promotion of inclusive and responsible Digital Finance Services (DFS). ACP Countries, EU Contribution: €25 million, Funding Instrument: 11th EDF (Intra-ACP)

Box 12: Digital 4 Development - Central Africa Backbone (CAB) Project – Central African Republic (CAR) Component

The project aims to reinstall terrestrial optical fibre links that interconnect the countries of Central Africa region providing broadband access from landing points of submarine cables. In the longer term it aims to contribute to the diversification of the Central African economy through fibre-optic access infrastructure to Cameroon and Congo, providing digital access to rural areas, increasing tax revenue and reducing the cost of economic and social transactions and creation of employment opportunities for young people. This project is funded by the African Development Bank, with a contribution from EU through EDF Regional Indicative Program for Central Africa of €17.5 million.

The project has four components, which encompass ICT infrastructure, Applications and ICT Services, Institutional support and capacity building and project management.

Component 1 (ICT infrastructure, €21.83 million) focuses on installation of 1,000 km of fibre optic from Bangui-Berberati-Gamboula (towards Kentzou border with Cameroon) and Bangui-Berberati-Lidjombo (towards Bomassa, border with Congo). A 50km urban local loop is also planned in Bangui to connect the national data centre to remote administrative sites. Twenty digital Community centres will be established.

Component 2 (Applications and ICT Services, €3.5 million) focuses on establishing a national data centre to support eGovernment and the installation of an eAdministration platform.

Component 3 (Institutional support and capacity building, €4.5 million) aims to implement a Public-private partnership for management of the fibre optic backbone and technical assistance to the regulatory authority (ARCEP) to regulate the wholesale market. Support will be provided to education institutions, operationalisation of a national ICT authority, technical support to the Ministry of Postal and Telecommunications in charge of ICT and capacity building of environmental protection agencies (DGE, WWF).

Box 13: Digital 4 Development - Cyber Resilience for Development - Cyber4D

The project aims to increase the cyber resilience of third countries while promoting an inclusive multi-stakeholder and rights-based approach and ensuring compliance with the rule of law and good governance principles. This project is funded as multi donor action with an EU contribution through Instrument contributing to Stability and Peace (IcSP) of €11 million. It has a 42 months duration.

The project has three components:

- (1) Strengthened Cybersecurity Policy, Strategic, and Coordination Frameworks and
- (2) Increased Cybersecurity Incident Response Capabilities.

The first two have a country-specific focus in up to 7 priority countries in Africa and Asia. The initial priority countries in Africa are Mauritius and Botswana.

(3) Fostered Networks of Cyber Expertise and Cooperation - focus on bringing different countries, regional and technical organisations together to share cybersecurity good practices globally on the basis of EU expertise and promote the creation of formal and informal networks in order to increase trust and cooperation at regional, trans-regional and international level.

The inception phase ran from December 2017 to August 2018, with the implementation phase commencing in September 2018.

Following approval of the inception report, sensitisation and assessment visits were undertaken to Mauritius, Botswana and Sri Lanka. There has been engagement with public and private sector stakeholders including representatives of critical national infrastructure bodies. Training has been provided to expert staff in National Computer Emergency Response Teams, which has assisted in preparing detailed needs assessment documentation. A project coordinator has been appointed in each country. They are responsible for supporting the development of detailed action plans to deliver National Cyber Security Strategies. They are also planning project launch events due in early 2019.

Box 14: Digital 4 Development - Policy and Regulation Initiative for Digital Africa (PRIDA)

The project aims to foster universally accessible and affordable broadband across the African continent (to unlock future benefits of internet based services). This project is funded through PANAF/DCI (BUDGET) with a contribution from EU of €7.5 million. It commenced in September 2017, with a 60 month duration.

Three outputs are envisaged:

Output 1: Predictable spectrum allocation, licensing, management including the treatment of harmful interferences and pricing based on international best practices with a forward looking approach towards the Internet of Things (IoT) is improved. This includes: analysis of current legislative and regulatory framework, usage of spectrum, fibre deployment for backhaul services; development of guidelines and case studies on national spectrum allocation, licensing and pricing; development of harmonised roadmaps for adaptation of current legislative and regulatory framework; development of harmonised spectrum reframing methods; development of guidelines and case studies for IoT, technical assistance and capacity building. An agreement was signed with ITU related to output 1 in November 2018 for 42 months.

Outputs 2: a) Development of Continental ICT/ Telecommunications Legislative and Regulatory Monitoring & Evaluation methodology; b) Strengthen Continental cooperation between national telecommunications regulatory authorities (NRAs); c) Raise awareness of cross cutting use of ICTs (policy) by public authorities and civil society

Outputs 3: Improve Capacity of African stakeholders active in the global internet governance

Outputs 2 and 3 are managed by AUC (Department of Infrastructure and Energy) with the support of a Technical assistance for which a service contract was signed with the consortium GFA-CARSA-Research ICT Africa on 20/10/2018, for a duration of 3 years. The Budget of the AUC is also supported through the African Union Support programme (AUSP). The programme formally started with a first Global Steering Committee organised on 10 December 2018.

Box 15: Digital 4 Development - Digital4Inclusion (ACP)

The project aims to deepen financial inclusion in ACP countries by promoting inclusive and responsible Digital Financial Services (DFS) ecosystems that can benefit poor people and entrepreneurs. It aims to do this by developing responsible, open and inclusive digital financial ecosystems based on knowledge and innovation in ACP countries and further develop and scale up innovative digital financial solutions based on multi-stakeholder alliances.

This project is funded through 11th EDF (Intra-ACP) with a contribution from EU of €25 million.

DG DEVCO has consulted with the ACP Secretariat on behalf of the ACP Group of States in relation to the guidelines for the Calls for proposals. DG DEVCO and the ACP Secretariat aim to finalise the financing agreement to facilitate Calls for proposals to be launched during January 2019. DG DEVCO plans to hold an Information Day in Brussels during February 2019. It is expected that projects approved under the Call will commence in the last quarter of 2019.

**Preparatory work for
Medium term actions**

Annex 2 of the Working Document outlines domains under which medium term actions could be undertaken. Initial preparatory work has been undertaken in the eGovernance, Energy, Health, Agriculture and

Education domains during 2018. This work will support consultations with DG Delegations to raise awareness of potential digital programme components to be included in future initiatives. Box 16 provides an overview of the initial focus and activities.

Box 16: Digital 4 Development - Status on Medium Term Measures (2018 - 2020)

The preparatory work has been undertaken in the eGovernance, Energy, Health, Agriculture and Education domains during 2018 for Medium Term Measures (Annex 2, SWD(2017) 157 final):

eGovernance domain - A study has been undertaken entitled "The deployment of e-governance systems in Africa" during 2018. It provides a mapping of African countries' readiness to implement eGovernance and eGovernment systems. It also provides the elements to allow for informed dialogue between EU Delegations and African partners and eventually to support pilot projects and/or national/regional initiatives for deployment of eGovernance solutions, including actions for identity/eSignature.

Energy domain - A preparatory study is on-going on the energy-digital nexus which focuses on financially sustainable business models of energy micro- and mini-grid investments that focus on delivering sustainable energy, digital and other services. Exploratory work is ongoing to identify digital –energy projects that involve private partners.

Health domain - Mapping of projects with e-/m-health components in the partner countries is ongoing with the aim to integrate digital components in the health programmes. Aim to start consultations with EU Delegations to raise awareness and sensitise the delegations towards opportunities to consider and promote the inclusion of digital programme components.

Agriculture domain - DEVCO is carrying out a short study, comprising a mapping of EU-funded projects in e-agriculture, a gap analysis of what type of projects could be funded and a discussion on future plans for post 2020.

Education domain - A study providing the mapping of types of projects/programmes supported by the EU in partner countries in the area of education & digital has been completed. Next step will be to deliver guidelines to the EU delegations on how to further increase the integration of digital components in digital education strategies in partner countries.

1.8 Overview of Innovation Spaces

North, Central and West Africa

Rapid Increase in Innovation Spaces since 2009 in Cairo, Giza and Alexandria, reflecting increased interest in Innovation and Entrepreneurship

Egypt recognises the ICT sector and innovation as key contributors to the development of the national economy. The Egyptian Government has made a significant investment in capacity building, digital literacy and certification of skills over the last decade. As the level of interest in innovation and entrepreneurship grew in recent years a number of Innovation Spaces active gradually emerging from 2009, including: *Technology Innovation & Entrepreneurship Center (TIEC)*⁸ in Cairo (which now also hosts the UNTIL Egypt Lab⁹ and is launching the IoT

Lab in Q! 2019); *The District Co-working Spaces*¹⁰ in Cairo and Maadi; *icecairo*¹¹, *American University of Cairo (AUC) Venture Lab*¹² (first university-based incubator in Egypt), *Flat6Labs*¹³; *Fab Lab*¹⁴; *GESR*¹⁵ Incubation and Innovation Lab; *Sustaincubator*¹⁶; *Ebni*¹⁷; (which is now part of the Borg Al Arab Innovation Cluster), *INJAZ Egypt*¹⁸; *Shekra*¹⁹ crowdfunding solution; *Alexandria Hackerspace*²⁰. In addition to the innovation spaces, many co-working spaces were established to support networking and coordination with the innovation stakeholders in the community. These Innovation Spaces range from supporting Pre-Incubation (*icecairo*, *AUC Venture Lab*, *Alexandria Hackerspace*), Incubation (*TIEC*, *AUC Venture Lab*, *Fab6Labs*, *Sustaincubator*) and Acceleration (*The District*, *TIEC*, *Fab6Labs*, *Sustaincubator*²¹), Co-working and meeting spaces (*The District*, *Fab Lab Egypt*, *Giza Hackerspace*, *El-Minya Hacker Space*, *Al Maqarr*²² (with locations in Greek Campus and Heliopolis, Cairo and *G Space* in ElGouna, Hurghada), *Muqaddima Coworking Space* - *GrEEK CAMPUS*²³, *Rasheed22*, *302labs*²⁴, *Innoventures Startup Circus*). In 2016 MCIT established Silicon Waha, which will establish six technology parks across Egypt, with the first three expected to be in place during 2017.

⁸ <http://tiec.gov.eg/>

⁹ <https://until.un.org/content/until-lab-locations>

¹⁰ www.district-egypt.com

¹¹ www.icecairo.com

¹² <http://schools.aucegypt.edu/business/aucvlab/Pages/default.aspx>

¹³ www.flat6labs.com

¹⁴ <http://fablab-egypt.com/>

¹⁵ <http://gesr.net/>

¹⁶ <http://www.sustaincubator.com>

¹⁷ <http://ebni.io/>

¹⁸ http://injaz-egypt.org/?page_id=16

¹⁹ <http://shekra.com/en/>

²⁰ www.alexhacker.com

²¹ www.sustaincubator.com

²² <http://www.almaqarr.com>

²³ www.thegreekcampus.com/

²⁴ <http://www.302labs.com/>

National Programme of Incubators initiated in 2009, with Innovation Spaces starting to emerge from 2011

Tunisia considers the development of ICT to be a national priority in terms of economic and social activities, health, e-learning, renewable energy and control of the natural environment. Since 1999 Tunisia has been committed to a national programme to establish business incubators within Higher Education Institutions through an agreement between the Ministry of Higher Education and Ministry of Industry. The first incubators were established in 2011, and there is now a network of

26 ISET incubators across the country. Other Innovation Spaces are gradually emerging to include WIKI Start Up²⁵, Reseau Entreprendre Tunis²⁶, Microsoft Innovation Center, Stanford Peace Innovation Lab²⁷, Elfabrika²⁸, Fablab ENIT²⁹, Tunis Fablab³⁰ and Fablab Solidarity Youth Science Tunisia. In the last two years, many incubators and innovation spaces have been launched that provide a mix of working space, training, coaching, and funding of startups particularly in the ICT sector, including: IntilaQ³¹, Flat6Labs³², B@Labs³³, Cogite³⁴, and Factory619³⁵ and COStart. The Centre for Innovation and Technological Development (CITD) is responsible for supporting private sector innovation.

Innovation Spaces emerging in the major cities of Yaounde,

Cameroon plays an important economic role in Central Africa. There are a number of Innovation Spaces active around the country including: *Cameroon Innovation Hub*³⁶ (Yaounde); *Centre for Entrepreneurship, Research & Innovation* (CERI)³⁷ hosted by Catholic University Institute of Buea and *ActivSpaces*³⁸ (Buea and Douala). Agro-Hub³⁹ is focused on agriculture. These Innovation Spaces are primarily focused on supporting pre-Incubation, Incubation and Acceleration. While CERI focuses on Science, Technology, Engineering and Maths disciplines, ActivSpaces is a tech hub focused on supporting web and mobile programmers, designers, researchers, and entrepreneurs. CIB is currently providing virtual support online.

Innovation Spaces are clustered in Dakar

Senegal considers ICT to be an essential contributor to national development. Innovation Spaces include MobileSenegal Hub⁴⁰, which was established as a virtual tech hub in 2008 to support training in

²⁵ www.wikistartup.tn

²⁶ www.reseau-entreprendre-tunis.org

²⁷ <http://peaceinnovation.stanford.edu/field-lab-network/tunis/>

²⁸ <http://elfabrika.tn/>

²⁹ www.facebook.com/FabLabENIT

³⁰ www.fablbtunisia.com

³¹ www.intilaq.tn/

³² www.flat6labstunis.com/

³³ www.biatlabs.com/

³⁴ <https://www.cogite.tn/>

³⁵ <https://factory619.com/>

³⁶ www.cihub.net

³⁷ www.cuib-cameroon.org/home.php?office=14

³⁸ <http://activspaces.com/>

³⁹ <http://agro-hub.com/>

⁴⁰ <http://mobilesenegal.org>

mobile technology; Jokkolabs⁴¹ which was established as a co-working space in 2010, followed by JokkoFabLab⁴² and Jokko Labs Saint-Louis⁴³ and CTIC Dakar⁴⁴, which was established in 2011 as a tech hub providing Pre-Incubation and Acceleration Services. Established in 2012, *Jjiguenetech Senegal*⁴⁵ is the first woman's tech Hub in Senegal. Innodex Incubator at ESP, Université Cheikh Anata DIOP provides office space, equipment and business mentoring. There are now a number of Fab Labs including Fab lab of ESP, EPT, IPSL and Keur Thioissane, Orange Fablab. UADB, UGB, UT and UASZ incubators. MobileSenegal is now the Mobile4Senegal Association.

East Africa

Limited donor funding key driver of the development of Innovation Spaces

Burundi is slowly building up its institutions and infrastructure following twelve years of crisis up to 2005. The *Burundi Business Incubator*⁴⁶ was set up in 2010 and has received financial and technical support through USAID and the Dutch Embassy to support training programmes and local capacity building. During 2013 the Segal Family Foundation piloted the *Social Impact Incubator* in Bujumbura as a capacity building programme and the first cohort graduated in October 2013. During 2014 in partnership with CARE International Burundi, the Social Impact Incubator took in another cohort of 24 incubatees. The *UNICEF Burundi Innovation Lab* is focused around technology for development; micro-energy rural entrepreneurship models and leveraging tools and mobile-based platforms to address national challenges. BBIN, Spark and UNDP supported youth to set up SMEs and community action groups in 2017. Spark also ran Dutch funding programs to support agri-business incubation – ABIN Programme from 2011.

Strong public sector commitment to strengthen National Innovation Ecosystem

Ethiopia is one of the fastest growing non-oil economies in Africa but is still heavily dependent on agriculture. In line with its ambition to become a middle-income country by 2025, Ethiopia views its ICT Policy and Strategy (revised 2016) as integral to the country's larger development goals. MCIT has established 300 Community Information Centres and 12 community radio stations across the country to provide information on new ICT technology transfer and implementations, healthcare, agricultural information and education issues. *Bahir-Dar ICT Business Incubation Center*⁴⁷ was established in November 2009 in Amhara Regional State to support ICT entrepreneurship targeting recent graduates. It provides office facilities, capacity building and advisory services. *iceaddis*⁴⁸ was established in two locations in Addis Ababa (hosted by EiABC and downtown) during 2014 to provide pre-incubation and Incubation support for technology graduates, final year students,

⁴¹ <http://jokkolabs.net/en>

⁴² <https://www.fablabs.io/defaralsalabo>

⁴³ <http://saintlouis.jokkolabs.net>

⁴⁴ <http://www.cticdakar.com>

⁴⁵ <http://jjiguenetech.com>

⁴⁶ <http://www.bbin.bi/>

⁴⁷ <http://www.amhara-incubation.org>

⁴⁸ <http://www.iceaddis.com>

professionals and entrepreneurs. EiABC also hosts a National FabLab next door to iceaddis. Other Innovations Spaces include xHUB⁴⁹ Innovative Society, Ethiopia Climate Innovation Center (ECIC)⁵⁰, SNNPRS ICT Business Incubation, Mekelle Information Communication Technology Business Incubation Centre, blueMoon Incubator⁵¹ (located in Addis Garage) and the parastatal Entrepreneurship Development Centre (EDC)⁵².

*One of the most vibrant
Innovation Ecosystems
on the Continent*

Kenya recognises the importance of ICT and Innovation in achieving the Vision 2030 objectives. In part due to its pro-Innovation Policy and Regulatory Environment, Kenya has experienced significant growth in Innovation Spaces (private, community driven and hosted by education and research institutions) since 2009 including FabLab⁵³ (2009) and Computing for Development Lab⁵⁴ (C4DLab, 2013) at University of Nairobi; iHub⁵⁵ (March 2010); @iLabAfrica (January 2011) and @iBizAfrica at University of Strathmore; m:lab East Africa (June 2011, activities now within iHub); Chandaria BIIC (July 2011) at Kenyatta University; Nailab⁵⁶ (August 2011); 88mph⁵⁷/Nairobi Startup Garage (August 2011), GearBox⁵⁸; Jomo Kenyatta University of Agriculture and Technology Center for Business Innovation - JKUAT-CBI; Regional Centre for Enterprise Development – IUPS and Enterprise Kenya⁵⁹ initiative founded by the ICT Authority (2015). These Innovation Spaces provide a mix of Pre-Incubation (iHub; @iLabAfrica; @iBizAfrica; Chandaria BIIC, Lakehub⁶⁰), Incubation (FabLab; C4DLab; Nailab; GearBox; JKUAT-CBI; Regional Centre for Enterprise Development – IUPS; KIRDI, ygap Kenya⁶¹) and Acceleration (Enterprise Kenya, Pangea Accelerator⁶²) services (Cunningham et al 2014⁶³). Some like 88mph/Nairobi Startup Garage have now closed operations. IBM set up a **ThinkLab**⁶⁴ in Nairobi to undertake basic and applied research focused on addressing African challenges.

⁴⁹ www.xhubaddis.com

⁵⁰ www.ethiopiaticic.org

⁵¹ <https://www.blumoonethiopia.com>

⁵² <https://www.edcethiopia.org>

⁵³ <http://fablab.uonbi.or.ke>

⁵⁴ <http://www.c4dlab.ac.ke>

⁵⁵ <http://www.ihub.co.ke>

⁵⁶ <http://www.nailab.co.ke>

⁵⁷ <http://www.88mph.ac/nairobi>

⁵⁸ <http://gearbox.co.ke/>

⁵⁹ <http://innovation.icta.go.ke/enterprise-kenya/>

⁶⁰ <http://lakehub.co.ke/>

⁶¹ <https://ygap.org>

⁶² <https://www.pangeaa.com/>

⁶³ Cunningham P., Cunningham M., Ekenberg L.. (2014), Baseline Analysis of 3 Innovation Ecosystems in East Africa, International Conference on Advances in ICT for Emerging Regions (ICTer 2014)

⁶⁴ <http://www.research.ibm.com/labs/africa/>

*Bilateral Support from
Finland supported
creation of
preIncubator*

Tanzania recognises the importance of ICT and Innovation to support socio-economic development as part of the realisation of Development Vision 2025. The ICT Policy of 2003 was reviewed and updated through bilateral support provided by Finland and new ICT Policy approved in 2016. Buni Hub⁶⁵ pre-incubator was established at COSTECH in October 2011 within the TANZICT⁶⁶ Bilateral project

(Cunningham et al 2014). Other Innovation spaces in Dar es Salaam also include Dar Teknohama Business Incubator⁶⁷ (DTBi - established in 2011 as a Public, Private Partnership between InfoDev and COSTECH;), the University of Dar es Salaam Entrepreneurship Centre (UDEC)⁶⁸, UDEC Business Incubator⁶⁹, Research and Development Network (RDN) Hub⁷⁰ and University of Dar es Salaam ICT Incubator⁷¹ (UDICTI), Biashara Lab TAYOA⁷², Niwezeshe Lab/Nlab⁷³, Energy Change Lab⁷⁴, EQWIP Hubs⁷⁵, TAREBI/IMED⁷⁶, STICLab⁷⁷, She Codes for Change⁷⁸, Jenga Hub⁷⁹, Ndoto Hub⁸⁰, Hub 255, SmartLab⁸¹, Seedspace⁸², AMCET Hub, dLab⁸³, Safe Space⁸⁴ and Sahara Accelerator⁸⁵. Innovation Spaces have been established in Dodoma (Microsoft Innovation Center - MIC TANZANIA at University of Dodoma⁸⁶, Arusha (Twende-AISE⁸⁷, Kakute⁸⁸, NM-AIST⁸⁹, Camartec⁹⁰, Ubuntu Hub), Iringa (VSO International T-LED, Rlabs Iringa, Kiota), Moshi (Anza Accelerator, Kilihub), Mtwara (VSO International T-LED⁹¹), Mzanza (Saint Augustine University, Ellimu Living Lab Sengerema, EQWIP Hubs, VSO International T-LED) and Zanzibar (EQWIP Hubs, ZTBI, Cube Zanzibar, Tanzania Youth Icon (TAYI)). The inauguration and Call for Investors for the Tanzania ICT Technology Park is planned for 2021/2022. KINU was established as a pre-

⁶⁵ <http://www.buni.or.tz>

⁶⁶ <http://www.tanzict.or.tz>

⁶⁷ www.teknohama.or.tz

⁶⁸ <http://udec.udsm.ac.tz>

⁶⁹ <http://udec.udsm.ac.tz/incubation.html>

⁷⁰ www.rdnplatform.com

⁷¹ <http://udicti.coict.udsm.ac.tz/>

⁷² www.tayoa.org

⁷³ www.niwezeshelab.org

⁷⁴ www.energychangelab.org

⁷⁵ <https://eqwiphubs.org>

⁷⁶ <https://imedtz.org/renewable-energy-incubation-program/>

⁷⁷ <https://sticlab.co.tz>

⁷⁸ <http://shecodesforchange.org>

⁷⁹ <http://jengahub.com>

⁸⁰ www.ndotahub.com

⁸¹ <http://smartlab.co.tz/>

⁸² www.seedspace.co/cities/tanzaniadaressalaam

⁸³ <https://dlab.or.tz>

⁸⁴ www.safespacetz.com

⁸⁵ <https://saharaventures.com/saharaaccelerate.html>

⁸⁶ <http://mictanzania.azurewebsites.net/>

⁸⁷ www.twende-tanzania.org/about.html

⁸⁸ <http://kakute.org>

⁸⁹ www.nm-aist.ac.tz

⁹⁰ www.camartec.go.tz

⁹¹ www.t-led.co.tz

incubator in July 2012 and closed in 2016; an Incubator opened by Mara Launchpad in Q1 2013 closed in 2014.

*Deregulation has
successfully created a
growing ICT sector*

Uganda's ICT sector is one of the country's most vibrant, fastest growing sectors since market liberalization in 2010, based on a sound ICT legal and regulatory framework. Uganda experienced a rapid growth in Innovation Spaces supporting entrepreneurs from 2010 to include: *Hive CoLabs*⁹² established as first tech hub in 2010; *Microsoft Innovation Centre* hosted by College of Computing and Information Science, Makerere University (established November 2011); *Outbox*⁹³ focused on mobile and web entrepreneurs (established July 2012); *Angels Hub*⁹⁴ (which took over Mara LaunchPad incubation space in September 2013); *iLab@MAK*⁹⁵ (established 2005), UN Global Pulse supported Pulse Lab Kampala⁹⁶, which focuses on applications of Big Data and the UNICEF supported Uganda Innovation Lab, FabLab Kampala⁹⁷ and Women in Tech Uganda (WITU) Hub⁹⁸ (established in 2012). The Innovation Spaces are focused on providing Pre-Incubation (Hive CoLab, Outbox), Incubation (Angels Hub, Women in Tech Uganda (WITU) Hub, FinAfrica⁹⁹, The Innovation Village¹⁰⁰, TechBuzzHub¹⁰¹), Co-working spaces (Hive CoLab, Outbox, The Hub¹⁰², Mawazo Innovation Hub, Innovation Village, TechBuzzHub), Entrepreneurial Training (FinAfrica) and commercialisation of apps (*Grameen Foundation AppLab*¹⁰³) (Cunningham et al 2014). . Other activities include the UNICEF supported Uganda Innovation Lab, UN Global Pulse supported Pulse Lab Kampala¹⁰⁴ and Telesat International¹⁰⁵ targeting students, CURAD – Consortium for enhancing University Responsiveness to Agribusiness Development¹⁰⁶; FabLab Kampala¹⁰⁷, business Innovation services provided by Uganda Industrial Research Institute¹⁰⁸, and NESTA and Brutish Council supported Global Innovation Policy Accelerator.

⁹² <http://hivecolab.org/>

⁹³ <http://www.outbox.co.ug/>

⁹⁴ <http://angelshub.org/>

⁹⁵ <http://cedat.mak.ac.ug/research/ilabs.html>

⁹⁶ www.unglobalpulse.org/kampala

⁹⁷ www.facebook.com/fablabkampala

⁹⁸ <http://witug.org>

⁹⁹ <http://www.finafrica.org/>

¹⁰⁰ <http://innovationvillage.co.ug>

¹⁰¹ <http://techbuzzhub.org>

¹⁰² <http://thehubkampala.com/>

¹⁰³ <http://www.grameenfoundation.applab.org>

¹⁰⁴ www.unglobalpulse.org/kampala

¹⁰⁵ <http://telesatinternational.net/>

¹⁰⁶ www.curadincubator.org

¹⁰⁷ www.facebook.com/fablabkampala

¹⁰⁸ www.uiri.org

Southern Africa

Economic

Diversification is a key policy imperative

Botswana is a middle-income country with relatively good infrastructure, fibre-optic networks and a National Backbone. The Government of Botswana decided at an early stage that it is necessary to actively support entrepreneurship. The *Local Enterprise Authority*¹⁰⁹

was established in 2004 to support SMEs, provide training, mentoring, technology adaptation and support services and now has incubators around the country; Pilane Multi sector Incubator (2009), Leather Industries Incubator (2010), Francistown Industrial Business Incubator (2011) and Glen Valley Horticulture Incubator (2011). The *Botswana Innovation Hub* (BIH)¹¹⁰ was conceived in 2008 to support economic diversification, job creation and transition towards a knowledge-economy. Programmes include ICT Technology Cluster, the First Steps Venture Centre, Mining Technology Entrepreneurship Centre (MTech Centre) and Cleantech Centre. BIH received support through the Southern African Innovation Support (SAIS)¹¹¹ Programme to establish a Global Business Lab¹¹² and Technology Transfer Office within the University of Botswana; develop a Demand Driven Supply Chain Business Incubation Model; and address youth unemployment and local communities through Living Labs and Training (RLabs Botswana). It is also a partner in the second phase of SAIS (2017 - 2020). The University of Botswana is hosting three Innovation Spaces: Global Business Labs Botswana¹¹³ (2013); Centre for Scientific Research, Indigenous Knowledge and Innovation (cESIKi) and the DESIS Lab¹¹⁴.

Public sector a key driver of the evolution of Innovation Spaces

Lesotho has a good policy framework. Innovation Spaces are gradually emerging around Basotho Enterprises Development Corporation¹¹⁵ (BEDCO), the School Technology Innovation Centre (STIC) and Innovation hub at the National University of Lesotho and the Vodacom Innovation Park launched in 2015. A Technological Business Incubator was also established and hosted by the Ministry of Communications, Science and Technology, while Nesta¹¹⁶ partnered with UNDP to establish a Growth Innovation Lab in Maseru. Living Lab Methodologies are used by the UNESCO - Science and Mathematics Educator's Federation (SMEF) Thakakhoali to support education activities.

Malawi's Vision 2020 recognises ICT as a priority sector with the potential to turn around the country's economy. Four Innovation Spaces have recently emerged. In early 2014, the Global Center for Food

ICT a public policy priority but at early stage of development

¹⁰⁹ www.lea.co.bw

¹¹⁰ <http://www.bih.co.bw/>

¹¹¹ <http://www.saisprogramme.com/overview/>

¹¹² <http://globalbusinesslabs.com/office/botswana/>

¹¹³ www.saisprogramme.com/global-business-lab-sets-up-shop-in-botswana-and-namibia/

¹¹⁴ <http://www.desisnetwork.org/courses/university-of-botswana-desis-lab/>

¹¹⁵ <http://www.bedco.org.ls>

¹¹⁶ <https://www.nesta.org.uk/latest/>

Systems Innovation¹¹⁷ at Michigan State University established a regional Innovation Hub focused on agricultural and food systems innovation, in partnership with the Lilongwe University of Agriculture and Natural Resources, leveraging financial support from USAID. In May 2015 UNICEF cooperated with the Polytechnic of Malawi to set up an Innovation Hub in Blantyre. Lilongwe mHub¹¹⁸ commenced activities in late 2015 with funding from Hivos Southern Africa as a pre-incubator and co-working space. InCUBE8¹¹⁹ was set up in 2016 as a business incubator, providing mentorship, technical and financial support in partnership with the Tony Elumelu Foundation Entrepreneurship Programme¹²⁰. Growth Accelerator Malawi¹²¹ is being implemented by mHub in partnership with GrowthAfrica and Accesserator (Dutch investment firm), supported by UNDP and the Royal Norwegian Embassy.

*ICT a key economic
pillar with strong public
sector support*

Mauritius has grown from an isolated mono-crop dependent country into a services-led economy enjoying sustained growth in just four decades. This has been a significant investment in infrastructure and capacity building to support ICT adoption. Innovation Spaces currently

supported by the Government of Mauritius include: StartMe Up¹²² (2017 – funded by National SME Incubators Scheme), NCB Technopreneurship Unit¹²³ (rebranded in 2017) and La Plage¹²⁴ (initiated in 2016). Other accredited business incubators include: Ceridian App Factory¹²⁵ (training), La Plage Factory¹²⁶ (incubation, co-working space), Mauritius Startup Incubator¹²⁷ (mentoring, office space), Turbine¹²⁸ (incubation, acceleration, co-working space), Ventures AA¹²⁹, Verde Ventures¹³⁰ and Ebene Accelerator (established by Ministry of Finance and Orange Mauritius Group). These offer a mix of Pre-Incubation, Incubation (physical and virtual) and Accelerator services.

*Public and international
donor support for
Innovation activities*

Mozambique historically has been dependent on subsistence agriculture, aluminium and foreign assistance. The ICT Policy, ICT Policy Implementation and the eGovernment Strategy were revised in 2015 to prepare the Information Society Policy, Information Society Strategic Plan and Information Society Operational Plan, which has been submitted for approval by Government. Mozambique Information and Communication Technology Institute (MICTI) was initially established within the University of Eduardo Mondlane to provide an

¹¹⁷ <http://gcfsi.isp.msu.edu/>

¹¹⁸ <http://www.mhubmw.com/>

¹¹⁹ <http://www.incube8mw.com/>

¹²⁰ www.tonyelumelufoundation.org/

¹²¹ <http://growmalawi.com/>

¹²² <http://www.mrc.org.mu/English/News/Pages/startmeup.aspx>

¹²³ <http://technopreneur.ncb.mu>

¹²⁴ <http://www.coworking.mu/incubator/>

¹²⁵ <http://ceridianlearningcentre.com>

¹²⁶ <http://www.coworking.mu/incubator>

¹²⁷ <http://www.mauritius-startup-incubator.com/en/mauritius-startup-incubator-home/>

¹²⁸ <https://www.turbine.mu/incubation/>

¹²⁹ <http://ventures.angloafrican.com/>

¹³⁰ <http://www.verdefrontier.mu/ventures/>

Institute for Research and Learning and a Business and Technology Incubator. A Science and Technology Park is being built at Maluana. Mozambique was a beneficiary of the Southern African Innovation Support (SAIS)¹³¹ Programme and STIFIMO Finnish Programme, both of which aimed to strengthen the national Innovation ecosystem. Recent players include: IPEME Incubator¹³²; MOZDEVZ¹³³ (2013) as a community of Application Developers and IDEARIO¹³⁴, which was launched in Summer 2014 as a tech hub and co-working space offering Pre-Incubation and a 30-day Acceleration Programme. IdeiaLab¹³⁵ was cooperating with the FemTech SAIS Programme in Mozambique. The Maputo Living Lab¹³⁶ was established in 2011 as part of a three-year project funded by the Province of Trentino Italy to build capacity through Summer Schools for students and pre-Incubation.

*Innovation Spaces
within HEIs, Innovation
Hub leveraging Demola
model*

Namibia is a middle-income country that is heavily dependent on extraction and processing of minerals and diamonds for export. As part of Namibia's Vision 2030, it aims to become a knowledge-based economy by 2030 and sees ICT as the critical sector for the Economic Development of the country. Innovation Spaces within Higher Education Institutions include FABlab Namibia Technology Centre¹³⁷ (established as a Centre of Excellence in 2014), Innovation Design Lab¹³⁸ and Namibia Business Innovation Institute (NBII)¹³⁹ - all at Namibia University of Science and Technology (NUST); and Global Business Labs Namibia¹⁴⁰ hosted at University of Namibia (UNAM), which was supported by SAIS Programme from 2013 to provide Acceleration services. The National Commission on Research, Science and Technology (NCRST) set up an Innovation Hub in Windhoek in 2016, which leverages the Demola concept¹⁴¹. The *Bokamoso Entrepreneurial Centre* (previously the Windhoek SME Incubation Centre) provided Incubation services and cooperated with FemTech Programme supported by SAIS Programme.

*Sophisticated market,
with FDI and multi-
stakeholder support*

South Africa's overarching vision for the role that the ICT's should play in achieving the development objectives for the country is captured in the National Development Plan. It states that: *"ICT will continue to reduce spatial exclusion, enabling seamless participation by the majority in the global ICT system, not simply as users but as content developers and application*

¹³¹ <http://www.saisprogramme.com/overview/>

¹³² www.ipeme.gov.mz

¹³³ <http://mozdevz.idear.io/sobre-nos/>

¹³⁴ <http://idear.io/>

¹³⁵ <http://www.ideialab.biz/>

¹³⁶ Ciaghi A, Villafiorita A, Chemane L, Macueve G, *Stimulating Development through Transnational Living Labs: the Italo-Mozambican Vision*, In IST-Africa 2011 Conference Proceedings, Paul Cunningham and Miriam Cunningham (Eds), IIMC International Information Management Corporation, 2011, ISBN: 978-1-905824-24-3

¹³⁷ <http://fablab.nust.na/>

¹³⁸ <http://www.nust.na/?q=centres/innovation-design-lab/about-idl>

¹³⁹ <http://nbii.nust.na/>

¹⁴⁰ <http://www.globalbusinesslabs.com>

¹⁴¹ <https://namibia.demola.net/>

innovators". South Africa has experienced a growth in Innovation Spaces that support technology entrepreneurs across the country including: The Innovation Hub¹⁴², mLab Southern Africa¹⁴³, which is hosted within the Innovation Hub since 2011; the Cape Innovation and Technology Initiative (CITI), BinarySpace¹⁴⁴; Codebridge¹⁴⁵; Eastern Cape Information Technology Initiative (ECITI)¹⁴⁶ Incubation programme; Invo Tech Incubator,¹⁴⁷ FabLab¹⁴⁸ (now 8 locations); Impact Amplifier¹⁴⁹; JoziHub / Jozi Hackerspace¹⁵⁰; Softstart BTI¹⁵¹; StartUp 90¹⁵²; SmartXchange¹⁵³; Workshop 17¹⁵⁴ in Cape Town; LaunchLab¹⁵⁵; Impact Hub Johannesburg¹⁵⁶; The House 4 Hack¹⁵⁷. These Innovation Spaces support Incubation (The Innovation Hub; ECITI; InvoTech; Softstart BTI; LaunchLab; SmartXchange, ygap¹⁵⁸), Co-working Spaces (JoziHub; Start-Up Garage; LaunchLab; Impact Hub Johannesburg; Workshop 17) and Acceleration Services (mLab SA; StartUp 90, Impact Amplifier). A UK-based not-for-profit, Nesta partnered with the African Leadership Academy to establish the Global Innovation Policy Accelerator in Johannesburg, South Africa.

*Early stages of
Innovation Space
development activity*

Eswatini (formally Swaziland) is a low middle-income country with a good policy infrastructure focused on the adoption of ICT to support socio-economic development. Swaziland recognizes the need for science and technological innovations in achieving its objections of

Vision 2022. The Royal Science and Technology Park (RSTP) has an IT Business Incubator (ITBI) and an Advanced School of IT (ASIT) housed within the Innovation Park at Phocweni. ITBI is focused on supporting commercialisation of innovations in the fields of computers, mobile phone, Internet and electronic products or processes. It provides working space, mentors, business and technical services and technology transfer services. The RSTP Biotechnology Park is focused on strengthening capacity in key areas including agriculture, plant, animal and medical biotechnology and biofuels, biofertilizers, biopesticides, biochemicals and bioenergy products.

¹⁴² www.theinnovationhub.com/

¹⁴³ www.mlab.co.za

¹⁴⁴ <http://www.binaryspace.co.za/>

¹⁴⁵ www.codebridge.co.za

¹⁴⁶ www.eciti.co.za/

¹⁴⁷ www.invotech.dut.ac.za/

¹⁴⁸ <http://www.fablab.co.za/>

¹⁴⁹ <http://www.impactamplifier.co.za/>

¹⁵⁰ <http://jozihub.org/>

¹⁵¹ www.softstartbti.co.za/

¹⁵² www.startup90.com/

¹⁵³ <http://www.smartxchange.co.za/>

¹⁵⁴ <http://workshop17.co.za/>

¹⁵⁵ <http://www.launchlab.co.za/>

¹⁵⁶ <http://johannesburg.impacthub.net/>

¹⁵⁷ <http://www.house4hack.co.za/>

¹⁵⁸ <https://ygap.org>

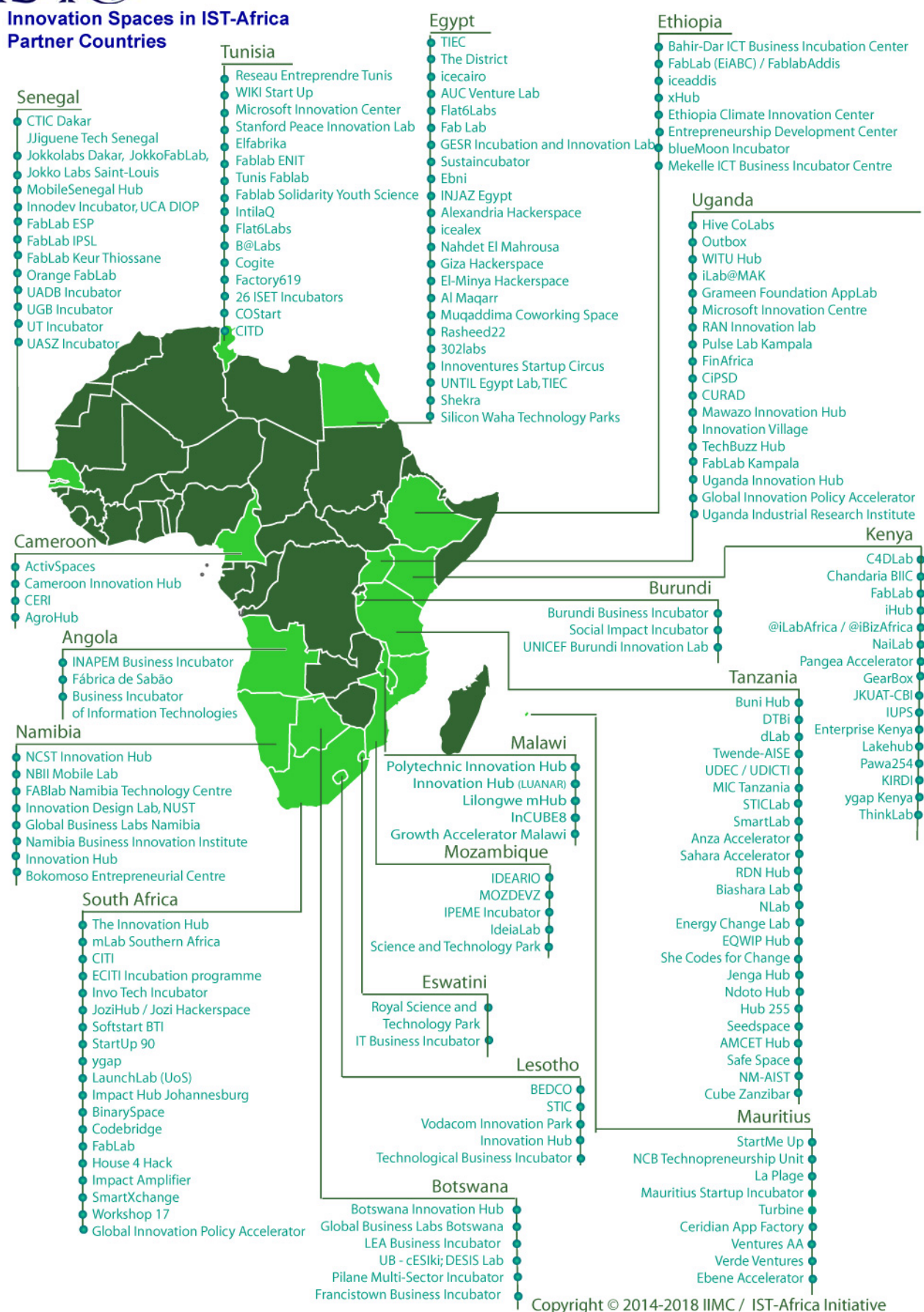


In 2018, the Central Bank of Eswatini in partnership with the RSTP, Eswatini Communications Commission (ESCCOM) and the Financial Services Regulatory Authority (FSRA) launched the **CBE Fintech Challenge**¹⁵⁹.

The map below (Diagram 9) provides a visual representation of Innovation Spaces in IST-Africa Partner Countries.

¹⁵⁹ <http://www.centralbank.org.sz/2018cbefintechchallenge/index.php>

Innovation Spaces in IST-Africa Partner Countries



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Diagram 9: Innovation Landscape in IST-Africa Partner Countries

1.9 Conclusion & Recommendations

In an African context ICT must be seen as a horizontal enabler in all areas of Service delivery including eHealth, eGovernment, eAgriculture, eEnvironment, eEducation and eInfrastructures. This requires adopting a multidisciplinary or interdisciplinary approach with input from a broad range of stakeholders including thematic content experts, computer scientists and user interface experts. The ability to deliver services (and in particular public services) using mobile technology is also critical. Common research areas across most IST-Africa Partner Countries include eHealth, Food Security and Sustainable Agriculture, Environment and Energy and Technology-enhanced Learning. There is often a greater premium placed on adapting technology to address local needs.

Clear public sector commitment to support ICT and Innovation

One of the most positive developments across IST-Africa Partner Countries is the demonstrable sustained commitment of the public sector to establishing the necessary infrastructure to leverage ICT to support socio-economic development. This is complimented by the priority given to regularly updating national legislative environments to address local societal challenges while taking account of (and adapting as required) international good practices. Increasingly these good practices are being shared between African Member States, providing opportunities to more easily adapt lessons learnt from other resource constrained environments.

Universities actively supporting Internal and external entrepreneurs

Another positive development is the clear commitment of the public sector in many IST-Africa Partner Countries to establishing and supporting Innovation Spaces to facilitate greater levels of national ICT-enabled entrepreneurship. While many Innovation Spaces were initially established either by the private or societal sectors, increasingly there is a trend for entrepreneurship support frameworks to be established and hosted directly both by research and innovation organisations (particularly universities) as well as public sector organisations. The network of Innovation Spaces established by the Government across Tunisia is quite impressive in scope. In other cases, Innovation Spaces are being established in partnership with public sector universities, often initially with support from UN bodies or other international stakeholders/ donors. In the case of Tanzania, the Tanzania Commission for Science and Technology (COSTECH) is providing support to universities to set up innovation spaces. As seen on Diagram 9 there has been a significant increase in the number of innovation spaces across Tanzania in the past number of years.

It is also striking how many universities have taken the initiative of more pro-actively addressing the employment opportunity needs of their graduates and supporting the entrepreneurial tendencies of undergraduates by establishing campus based Innovation Spaces. This reflects the simple reality that there are not enough public or private sector jobs for recent graduates, often leaving the difficult choice between staying and continue looking for any starting position, or go abroad to another country where graduate employment opportunities may be greater. In some cases, the same

institution has established Innovation Spaces affiliated with particular departments or faculties that take a more thematically focused approach to the project ideas and interests of the potential or prospective entrepreneurs they support. What is most impressive, is that most university based Innovation Spaces have taken the enlightened decision to set aside a percentage of available places for potential and emerging entrepreneurs that are not necessarily graduates of their institution. It is troubling however, that families seem to often prioritise a university education without clear employment opportunities over vocational or skills based training which can often be achieved quicker or on a part time basis, and for which many employment opportunities already exist.

Mapping of Innovation Spaces

Operational Innovation Spaces supporting ICT entrepreneurship and Innovation related activities have been identified in IST-Africa Partner Countries and a map of Innovation Spaces was created (Diagram 9). It addresses the need of interested African, European and other international stakeholders to access comprehensive up to date information on Innovation Spaces across Africa. This information is subject to change and suggestions for additional Innovation Spaces that should be recognised are much appreciated, together with necessary contact information for follow up.

Breadth of ongoing activities

This reports documents the current state of ICT and Innovation related policy making, infrastructure, initiatives, national ICT research priorities, research and Innovation focus within Higher Education Institutions, common priority areas in the context of the Horizon 2020 ICT-39-2017 Call, a mapping of research and innovation capacity in IST-Africa Partner Countries to Horizon 2020 LEIT (Leadership in Enabling and Industrial Technologies) and Societal Challenges priorities, as well as showcasing those African institutions who successfully participated in FP7 and Horizon 2020 projects, including organisations from IST-Africa Partner Countries in North Africa (Egypt, Tunisia), West Africa (Senegal), East Africa (Burundi, Ethiopia, Kenya, Tanzania, Uganda), Central Africa (Cameroon) and Southern Africa (Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland). Table 6 also provides insights into Horizon 2020 participation from other African Member States including: Angola; Algeria; Benin; Burkina Faso; Cabo Verde; Democratic Republic of the Congo; Gabon; Gambia; Ghana; Liberia; Libyan Arab Jamahiriya; Madagascar; Mali; Morocco; Nigeria; Rwanda; Togo and Zambia.

Significant improvement in eInfrastructure

There are currently an impressive range of national ICT Initiatives related to eInfrastructure, Innovation and Entrepreneurship, eGovernment, eHealth, Cyber Security and ICT Skills Development. There has been a significant investment in eInfrastructure over the past decade in many IST-Africa Partner Countries, including strong investment in implementing national ICT backbone, Internet Exchange Points and increased redundancy in terms of access to multiple submarine cables. As at September 2017 thirty-two African Member States have operational Internet Exchange Points (IXPs) and regional IXPs have been set up in East Africa (Kenya,

Rwanda), Southern Africa (South Africa, Zimbabwe) North Africa (Egypt), Central Africa (Congo, Gabon) and West Africa (Nigeria). This also showcases the impact of AfricaConnect 1 and 2 in terms of making it more affordable for African Member States to collaborate in facilitating cross-border infrastructure, and support of AXIS and the World Bank to implement national and regional IXPs to facilitate national and regional traffic, which historically might have been sent over expensive international connections. A functional National Research and Educational Network (NREN) has been established in most of the IST-Africa Partner Countries to support networking and access to Digital Repositories across national Higher Education Institutes and other educational institutions. It is noteworthy that some of these are now widely recognised as being worldclass in terms of impact.

*Mapping of
research
priorities and
research and
innovation
capacity*

To assist parties interesting in preparing research and innovation proposals, IST-Africa undertook a comprehensive pan-African consultation process to map national priority areas (including societal challenges) to inform the context of the ICT-39 Horizon 2020 Calls as well as creating a mapping of key departments in some of the key national institutions with necessary research and innovation expertise in the prioritised themes identified for the ICT-39 Call (Table 3, Diagrams 2, 3 and 4).

A mapping of research areas relevant to Horizon 2020 has been undertaken to raise awareness of specific African institutions with the required capacity to participate in proposals submitted in cooperation with their European peers, irrespective of whether open calls are focused on Africa. Horizon 2020 is completely open to International Cooperation, and there is a strategic opportunity for Europe to actively engage with partners from resource constrained environments with whom there are potential opportunities for research and innovation collaboration as well as future trade. Designing research projects so they actively explore the implications of research constraints has significant potential for wider exploitation of research results, both across Europe and beyond. The strategic advantage of collaborating with partners in Africa as against other regions of the world is that are often (for good and bad) existing connections between Europe and Africa, similar or at least relatable cultures, common languages and Africa and Europe are in similar time zones, making collaboration easier than with Asia for example.

Existing partnerships should take the opportunity to look carefully at upcoming calls under Horizon 2020 (and HorizonEurope when it is launched) as a mechanism to continue their successful collaboration, to maintain and build upon knowledge transfer and capacity building, and explore opportunities to add African partners to existing consortia where opportunities exist for potential adaptation to resource constraints. Tables 4 & 5 provide an overview for each of the IST-Africa Partner Countries of the main research institutions, research areas of interest and mapping to Horizon 2020 Calls under the LEIT (Leadership in Enabling and Industrial Technologies) & Societal Challenges work programmes. This overview is designed to help interested parties to quickly

identify potential partners in specific thematic areas by IST-Africa Partner Country. Please read the individual country chapters for more detailed information in relation to institutional research capacity.

Digital4Development

It is positive that the European Commission launched the Digital4Development framework in 2017 to both raise awareness of the opportunities and benefits of including digitisation and appropriate use of ICT in development projects funded under EDF 11 and other funding mechanisms. It builds on investments made in eInfrastructure networks, policy harmonisation, cyber resilience and digital technology projects. Boxes 11 - 16 provide insight into the focus and current status of short term and medium terms actions that are ongoing. A challenge for Digital4Development is that it does not have a dedicated budget or funding instrument. As a result projects need to leverage existing funding mechanisms such as European Development Funds, Horizon 2020, Erasmus+ and the Development Cooperation Instrument. As a result there is quite a lot of coordination required to kick start new projects. It is also vital that DG CONNECT includes calls focused on African social challenges in the 2020 Work Programme of Horizon 2020 and in work programmes of Horizon Europe to support this initiative.

In summary there are a number of points that should be considered in future planning:

1. Improving eInfrastructure and Good Legal Framework

Regular review of ICT Policies to ensure fit for purpose

While many of the targeted IST-Africa Partner Countries are at different levels of socio-economic, research and innovation development, investing in strengthening eInfrastructures, cost effective Internet access, resilient national and international connectivity and keeping the legal framework to support ICT activities up to date and responsive to lessons learnt as well as relevant international good practices, are seen as being important priorities in achieving the perceived benefits of the Information Society and Knowledge Economy. It is clear that it is critically important to regularly review ICT Policies every 18 – 24 months to take cognisance of changes in the market and societal needs as well as technological innovations to ensure that these are still fit for purpose. As outlined in this report, many IST-Africa Partner Countries have undertaken reviews in the past five years. However, for some countries, it may be beneficial to increase the frequency of such reviews to allow faster reaction to socio-economic, regulatory and innovation related developments. In an era of globalisation, it is important to also take account of inputs from key stakeholders of influence (including funding agencies and donor organisations), irrespective of national borders. Increasingly, economies in Africa are becoming more open of necessity, and it is important to not take a narrow perspective when shortlisting key stakeholders who could usefully be consulted on such occasions.

Leveraging NRENs effectively

As outlined in Table 1 a significant number of IST-Africa Partner Countries now have functional National Education and Research Networks (NRENs) in place. All IST-Africa Partner Country NRENs are members of UbuntuNet Alliance, WACREN or ASREN based on their geographic location. These regional networks now provide access to the benefits of AfricaConnect 1 and AfricaConnect 2

Infrastructure projects focused on supporting pan-African high-capacity Internet networks connected to the European GÉANT network (see Box 1). This will ultimately facilitate students, researchers and academics within Africa and between Africa, Europe (and the rest of the world) to interconnect and share both research and innovation related resources as well as virtual tools.

Increased number of Internet Exchange Points

Internet Exchange Points (IXPs) have now been established in thirty-two African Member States, either as a national strategic activity or through support from the AXIS project managed by the African Union Commission with funding from the government of Luxembourg. National and Regional IXPs quickly pay for themselves by facilitating local, national and regional traffic, which could otherwise soak up expensive international connectivity on submarine cables to Europe or the USA..

Recommendation: It is recommended that the role and expected contributions of NRENs continue to be clearly articulated and prioritised at national policy level as well as in national implementation plans. The potential role of NRENs should also be carefully considered in the context of EDF11 and EDF12, particularly in the context of potentially supporting a wider constituency than simply education and research stakeholders. In some countries, NRENs provide reliable, cost effective connectivity to public institutions as well as schools at secondary and even primary level.

AfricaConnect 3 provides an important opportunity to further enhance the research and innovation environment across the African continent by providing a framework to both conduct and foster credible national and international research and innovation collaboration in a cost effective manner. It is important that the necessary level of national Government support (including financial resources) is made available to ensure that each African Member State who has not already done so, can fully benefit from the 80% co-funding available under AfricaConnect. This could be facilitated by adopting a proactive approach to the requirement in all new National Indicative Plans under EDF11 that ICT is actively leveraged to support national priorities supported by DG DevCo funding. A functional NREN can be seen to support activities that would improve the impact of almost any NIP priority, especially where wider potential constituencies are considered.

It is recommended that National Research and Education Networks consider how they can cooperate with those Higher Education Institutions hosting Innovation Spaces as well as other not-for-profit Innovation Spaces to further strengthen National Innovation Ecosystems by providing access to virtual resources and tools to support applied research and innovation activities.

2. Growing Awareness of the Role of Multidisciplinary/Interdisciplinary Research

While there is a growing interest in undertaking research and innovation, supporting by an ever expanding number of Masters and PhD programmes across IST-Africa Partner Countries, there are still a number of practical resourcing challenges that need to be addressed. These include issues

such as access to necessary specialist skills as well as funding, and gaining access to both mentors and researchers with practical research and innovation experience they are willing to share.

Recommendations: It is recommended that each African Member State regularly updates its research and innovation agenda to provide an easily operationalisable road map for research and innovation activities that are well aligned with current and aspirational national policy priorities.

It is recommended that the focus of Masters and PhD Programmes are clearly aligned not only with the existing research and innovation capacity in the country, but also with national policy priorities. To achieve sustainable socio-economic impact, post-graduate studies must be adapted to address national policy priorities as well as current and aspirational national needs, particularly in rural or other low resource environments. As a result of improving eInfrastructure it is now increasingly possible to engage with institutions both across and beyond the country. This facilitates inviting potential partners from other institutions as guest lecturers, visiting professors and research fellows. They can also share specific expertise via video conferencing based lectures and virtual tools.

It is recommended that researchers actively leverage the opportunity to engage with their peers in other departments with expertise in other thematic areas to explore opportunities to undertake multidisciplinary and interdisciplinary research and practitioner projects addressing national and regional societal challenges. As ICT is increasingly leveraged as a horizontal enabler for public and private service provision, it is important for technology experts to actively engage with thematic, sectoral and usability experts to ensure that research, innovation and practitioner outputs can have a sustainable socio-economic benefit by addressing the needs of local end-user communities.

It is recommended that all research and innovation activities whether at Masters or PhD level should include a mandatory process of engagement and consultation with other innovation ecosystem stakeholders (and in particular representatives of end-user communities) to ensure that any research and innovation activities are co-designed around end-user engagement for wider impact.

It is recommended that African Governments work proactively with the RECs (Regional Economic Communities), the African Union Commission and the wider international community to prioritise the establishment of National and Regional Research and Innovation Funds that encourage research and innovation as well as practitioner projects to be undertaken by multidisciplinary and interdisciplinary teams ideally from several institutions. These multi-institutional teams could either be from the same country or from countries with common cross-border challenges. This approach will build the necessary track record of team-based research and innovation to attract international cooperation and support setting up both national and regional Centres of Excellence in the future.

It is recommended that there are clear, cost effective mechanisms at national and regional level to publish research and innovation outputs on an Open Access basis. The objective is to ensure that results and outputs of research and innovation activities are available for consideration both by the wider research and innovation community, as well as by national and regional policy makers.

Supporting the inclusion of researchers from relevant organisations in other African Member States will also support cross-border requirements related to research, innovation and commercialisation.

3. Growing Participation in EU Funded Research Programmes

There was a significant increase in participation from African research institutions during FP7 (Diagrams 5 and 6), which provided the necessary track record undertaking collaborative research and innovation at international level and experience working with cross border research teams.

*H2020
Research &
Innovation
funding to date
of €91.9 million
to 35 African
Member States*

As at September 2018 there are over 625 participations from 364 organisations across 35 African countries involved in 279 Horizon 2020 projects, bringing research funding in excess of €91.9 million into African research centres and universities (Diagrams 7 and 8). Seventy six percent of these funds (€69.9 million) have been secured by institutions based in IST-Africa Partner Countries.

Within the LEIT Work Programmes of Horizon 2020, IST-Africa provided the necessary evidence to secure Member State and European Commission support for two dedicated ICT Calls focused on addressing the needs of end-user communities in Africa. Twenty six million euro was allocated to ICT-39-2015 (Research and Innovation Actions) and ICT-39-2017 (Innovation Actions). There was a very strong response to both the ICT-39-2015 (47 proposals submitted) and ICT-39-2017 Calls (71 proposals submitted), with high quality submissions. There were also some African focused calls under the Societal Challenges Work Programmes (2015 - 2017 Calls), which were also over subscribed. This provides clear evidence of the mutual interest and benefit for both African and European research institutions to cooperate to address Africa focused research and innovation challenges.

It is important to remember that Horizon 2020 is completely open to International Cooperation, and that such African focused calls should provide opportunities to further strengthen African participation by showcasing African talent in clearly articulating local societal challenges. The objective of African institutions should be to be invited to be included in consortia addressing calls that are not necessarily focused on African participation, based on their track record and credibility, and explore how research outputs can be adapted to resource constraint environments.

Recommendations: African and European research institutions should actively look for opportunities to cooperate on relevant projects across all Work Programmes, irrespective of whether Africa in particular or international cooperation in general is mentioned in the call. Unfortunately, under Horizon 2020, many European institutions still interpret International Cooperation not being mentioned in a specific call as not encouraging such cooperation. This is a missed opportunity.

It is recommended that African researchers actively engage with peers in Europe to regularly explore and identify opportunities for cooperation under Horizon 2020 as well as national and international donor funding programs for which participation rules may vary. A lot of such

institutional relationships already exist from students studying abroad, PhD supervisors and participation at scientific conferences. These opportunities should be more actively leveraged.

It is recommended that European researchers actively look for opportunities to collaborate with African institutions on relevant thematic areas across Horizon 2020 Work Programmes. This can provide opportunities to both design and validate emerging innovation in resource-constrained environments, without all the common assumptions of access to cloud resources and infrastructure.

It is recommended that the European Commission continue to include dedicated calls focused on addressing African priorities in future Horizon 2020 Work Programmes and Horizon Europe Work Programmes across all relevant thematic areas. Priority common thematic areas include food security and agriculture, Health, Energy, Environment, Learning and eGovernment/eServices. This includes regular and scaled funding for both Research and Innovation actions, Innovation actions and Coordination and Support Actions to support this community and engagement with this community. There is a need for dedicated funding for each of these instruments, to ensure that all appropriate opportunities to accelerate the development of African research and innovation capacity and further strengthen institutional linkages between European and African researchers.

To support greater awareness of opportunities under Horizon 2020, it is recommended that all African Governments appoint a National Contact Point (NCP) for ICT and other relevant thematic areas for Horizon 2020 and provide them with the necessary assistance to be adequately trained for this activity. While significant progress has been made in this regard by many IST-Africa Partner Countries, NCP roles are often after thoughts added to existing responsibilities, without necessarily an understanding by senior management of the strategic importance of such a role, the necessity of appointing highly qualified candidates based on track record and providing them with the necessary time and resources required to adequately do this important and often time consuming work. However, the potential impact of this work being done effectively is extremely high.

For this reason, it is recommended that the role of the National Contact Point is institutionalised in the formal job description of NCPs working for Ministries and public Universities. The objective is to ensure they have dedicated time and resources to engage with and support the national research and education community on a sustained and ongoing basis. It also makes them more accountable for their work, which will further enhance the level of professionalism and commitment already demonstrated by most existing African NCPs. The greatest threat to the effectiveness of African NCPs is lack of allocation of dedicated time and resources to engage with key stakeholders and to engage with African and European NCPs to share good practices and strengthen relationships.

2. REPUBLIC OF BOTSWANA

2.1 Introduction

The Republic of Botswana is in Southern Africa. Botswana is bordered by Namibia on the west and north, Zambia at a narrow strip in the north, Zimbabwe on the east, and South Africa on the east and south. Botswana has an area of 581,730 sq km with an estimated population of 2,154,863 million inhabitants (2017 Botswana Demographic Survey) and a literacy rate of 88.5%. 63% percent of the total population is between 15 and 64 years of age. Gaborone, the capital city, has a population of about 269,000 (2018). The official language is English.



Botswana has maintained one of the world's highest economic growth rates since independence in 1966. This is largely attributed to diamond mining, with Botswana having one of the world's largest diamond reserves. The revenue earned from diamonds are the primary driver of the Botswanan economy. However, recent economic and political changes in the region encouraged the Government to explore other means of diversifying the economy as dependence on mineral wealth forms a narrow economic base which is not sustainable. The Government established a Botswana and Economic Advisory Council (BEAC) in August 2005, who developed the "Botswana Excellence -- A Strategy for Economic Diversification and Sustainable Growth" and Action Plan. The Action Plan outlines projects aimed at driving implementation of the Economic Diversification and Sustainable Growth Strategy. Cabinet approved the Action Plan and Strategy in December 2006 and November 2008 respectively. The first National Vision lapsed in September 2016. It has been replaced by Vision 2036, which aims to transform Botswana from an upper middle-income country to a high income country by 2036. Botswana Statistics indicates that the real 2017 GDP per capita is 40,779 pula.

The development of a national ICT framework is perceived as a shift from a factor endowments economy to an efficiency driven economy that will pave way to an innovative driven economy. In this context Botswana's first National Information and Communications Technology Policy was approved by Parliament in 2007 [Maitlamo National Policy for ICT Development 2007]. In terms of ICT infrastructure, there are two diversified fibre links to South Africa. There are also 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 both local and international fibre-optic networks to strengthen communication infrastructure. These include: NEPAD-Led Undersea Cable, East African Submarine System (EASSy), West African Ffestoon

System and West Africa Coast Cable System (WACS). The National Backbone (TransKalahari Fibre Optic Ring) was installed in 2008 and funded by Botswana Telecommunications Corporation (the national incumbent fixed line operator). These cross-border fibre optic cable connections connect Botswana to South Africa, Namibia, Zambia and Zimbabwe. The Internet Exchange point set up in 2005 significantly enhanced national connectivity.

In relation to telecommunications, according to Botswana Communications Regulatory Authority 2018 Annual Report there were 141,835 fixed phone lines subscriptions (a fall from 161,641 in 2016), 3.181 million mobile phone subscriptions (a fall from 3.46 million in 2016), 40,164 ADSL broadband subscriptions (a significant increase from 31,301 in 2016) and 10,350 fixed wireless broadband subscriptions at March 2018 (again with a significant increase from 3,180 in 2016). Teledensity of mobile telephony was 157% in March 2018 (falling from 171% in March 2016) and mobile Internet penetration has increased by 9% from 1.404 million in March 2017 to 1.523 million in March 2018. Teledensity for fixed telephony is 7%.

Further penetration of ICTs, especially in rural areas, to bridge the digital divide is necessary to continue the development and integration of Botswana into the global economy. A number of infrastructure projects, such as submarine optic fibre cables linking the west and east coasts of Africa, were undertaken to improve reliability, capacity and speed of the national network, and thereby ensure better interconnectivity with neighbouring countries and globally. WACS and EAssy provide capacity of 98Gbps and 22Gbps respectively. Botswana international Internet Exchange Points of Presence are in United Kingdom, South Africa, Djibouti. 8,000km of fibre has been laid nation wide, connecting cities, towns and villages, providing an information high way.

There are now 4 public universities and 4 private Universities as well as about 40 Higher Education Institutes including DVET. Twenty of these are public.

2.2 ICT Background

The National Information and Communications Technology (ICT) Policy builds on Government initiatives and aims to assist in achieving Vision 2036 by serving as a key catalyst in achieving social, economic, political and cultural transformation within the country.

The Botswana telecommunications market has three Public Telecommunications Operators (PTOs); Botswana Telecommunications Corporation Limited (BTC), Mascom Wireless Botswana (Pty) Ltd (Mascom) and Orange Botswana (Pty) Ltd (Orange). Botswana Fibre Networks (BoFiNet) was licensed in 2013 to provide wholesale services to other licensed service providers. Along with the major players are smaller players, the Internet Service Providers (ISPs), which provide value added services and internet on a smaller scale than PTOs and the Private Telecommunications Network Licence (PTNL) providers licensed to build private networks for internal business use.

The development of the National ICT Policy actively involved a wide range of participants from the public and private sectors, and civil society. It also took into account that relatively few people in

Botswana own PCs or have access to the Internet at home. Many users rely on access to PCs and the Internet through employment or while receiving an education.

The overall objectives of the ICT Policy are to assist with three specific outcomes:

- Creation of an enabling environment for the growth of an ICT industry in the country;
- Provision of universal 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.

To manage its complexity, the National ICT Policy is developed in the following key areas:

- Establishing the National ICT Vision, Goals and Objectives - to identify desired outcomes
- E-Readiness and Benchmarking – to establish the current level of ICT diffusion
- National ICT Policy – to identify and explain the key programmes and projects that are required to achieve the National ICT Vision, Goals and Objectives
- National ICT Master Plan – to define the various programmes and projects in greater detail, identifying the project deliverables, timelines, resources, programme dependencies and preliminary cost estimates
- An ICT Monitoring and Evaluation Programme – to measure progress and benefits achieved

In December 2010, an ICT Committee was constituted in the National Assembly. This was a promising development, as it provides a framework for Parliamentary oversight of National Policy in this important domain. The Ministry of Transport and Communications reports to the ICT Committee on the implementation of Maitlamo.

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, which has elapsed and succeeded by Vision 2036, National Development Plans and Millennium Development Goals.

The National Research, Science and Technology Plan (2006 - 2011) highlighted the requirement to leverage Research and Technology Development (RTD) and Innovation cooperation through the Framework Programme for RTD, capacity-building under UN-Habitat, various technology platforms and partnerships. ICT, Innovation and the Information Society at large are highlighted as a key tool for achieving its development objectives. To conduct needs-based research and development in focused areas in accordance with national priorities, there are key institutions in addition to universities and other Higher Education institutions including: national research Institutions: Department of Research Science & Technology (DRST) under Ministry of Education responsible for coordinating research & innovation in the country, bringing researchers and the industry together; Botswana Institute of Technology Research & Innovation (BITRI), a parastatal under the Ministry of

Tertiary Education Research Science and Technology, established in 2012 to conduct needs-based research and development in focused areas; Botswana Innovation Hub (BIH) innovative and networked organisation that promotes technology, entrepreneurship and commercialisation; Botswana National Veterinary Laboratory Research on Animal Health concentrating on animal health; Botswana National Food Research Centre (NAFTEC) taking care of food security; and the Joint Research Committee (Government, Academia, Public) which brings researches and the industry together.

BITRI focuses on two thematic research areas: Natural Resources and Materials (Building Materials, Climate Change, Nanomaterials) and Technologies (Electronics and Communications, Energy, Information Systems and Technology). BITRI has a five-year strategic plan for 2015-2020 plan, which focuses on three main themes: Research and Development, Strategic Partnerships and Organizational Excellence. It is currently being implemented.

Botswana is making significant progress on innovation. The Botswana Innovation Hub and its subsidiary company occupied the initial phase of the Icon Building at the Science and Technology Park in December 2017. The park presents new developments, which aim to improve Botswana's digital infrastructure and therefore putting BIH in a key position to be a significant driver of Botswana's digital economy. The joint venture between the BIH and Dimension Data joint venture (local ICT company) will deliver a Tier Three Accredited Data Centre to offer Park tenants and clients outside the Park tailored ICT Services, BIH has also broadened the scope in the areas of Water Technologies and Solar. The deployment of a Mobile Water Treatment Plant in Zoroga demonstrates the power of harnessing the ecosystem to deliver impactful solutions

Botswana has created a converged communications regulatory environment by establishing the Communications Regulatory Authority Act of 2012 [No. 19 of 2012] to replace the previous separate regulation of telecommunications and broadcasting (Telecommunications Act (72:03) and the Broadcasting Act (72:04)).

Botswana Telecommunications Authority (BTA) was established as an independent regulatory body to create and sustain an effective 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), which was launched in April 2013. It is an independent telecommunications regulatory authority as per CAP 72:03, vested with authority to regulate and supervise all aspects of telecommunication common carriers and service providers that fall under its jurisdiction. The BOCRA is also mandated by the Broadcasting Act (CAP 72:04) to offer Secretariat services to the National Broadcasting Board (NBB) with regard to technical matters. BOCRA has a core mandate to create a transparent enabling regulatory environment through: managing the frequency spectrum; resolving industry disputes; setting industry standards; setting tariff principles and appropriate guidelines. BOCRA also ensures compliance with communications services regulatory framework through the management and

monitoring of: service quality; customer satisfaction levels; broadcasting content; frequency spectrum; and terms and license conditions.

The issuance of service neutral licenses to Botswana's three major telephone and mobile operators in the market (Botswana Telecommunications Corporation, Mascom, Orange and beMobile) is viewed as liberalization of Botswana's telecommunications industry. The license authorizes the three operators to provide national public telecommunication services over fixed or mobile, wire line or wireless, network links, using any available technology. However, BTC is the only fixed line operator in Botswana.

In 2012 BTC was split into two separate entities: Botswana Fibre Networks (BoFiNet) which is responsible for backbone fibre infrastructure access (wholesale focus) and BTC which is retail in focus and will be privatised.

Botswana is also hosting the Telecommunications Regulators Association of Southern Africa (TRASA) Programme office. TRASA is responsible for harmonisation of the Postal and Information Communications and Technologies (ICT) regulatory environment in the SADC region in order to improve the Postal and ICT business environment and investment climate in SADC.

In relation to the licensing of Postal Operators, BOCRA continues to attract new market entrants to the postal market. By March 2018, the Authority licensed two more commercial postal operators: MontelView Holdings (Pty) Ltd trading as Droplt and NorthGuys Messaging & Couriers (Pty) Ltd. These brought the total number of licensed postal operators to 22 commercial postal operators (courier companies) and one public postal operator, being BotswanaPost. Because of the diversion to electronic communication the commercial postal market recorded a total mail volume of 867 566 postal items compared to 1 279 093 postal items registered during the 2016/17 financial year.

An eGovernment Strategy was launched in 2012 and is coordinated by the Office of the President. eGovernment implementation is still ongoing with plans to iteratively provide most services online. The GDN Evolution project is ongoing to upgrade and convert the current network to a unified communication network that is able to deliver data, voice, video and Wi-Fi services all in one managed network.

In September 2015, a new and converged licensing framework was implemented to create a more conducive environment for ICT development. The framework has two major categories: Network Facilities Provider (NFP) Licence and the Services and Applications Provider (SAP) Licence. All PTOs, BoFiNet, PTNLs and few of the ISPs still held licences provided for under the old licensing framework were to migrate to the new licences in June 2017.

The Electronic Communications and Transactions Bill were approved in 2013. The implementation of the National Public Key infrastructure (PKI) is envisaged.

2.3 Current ICT Initiatives and projects

ICT Initiatives primarily focus on addressing the Digital Divide, as well as programs supporting eGovernment, Innovation and Entrepreneurship. These include:

- Connecting Communities Programme
- Kitsong Centres
- Thuto Net
- Government On-Line
- Privatisation of the Botswana Telecommunications Corporation (BTC)
- Support for Entrepreneurship (including Botswana Innovation Hub)
- Broadband Strategy & Universal Access and Services (UAS)
- Cyber Security Strategy
- Postal Infrastructure
- Infrastructure Sharing
- Pan African e-Network Project

2.3.1 Connecting Communities Programme

This Programme was focused on providing demand driven information relevant to the needs and conditions of the local people. With the purpose of connecting communities in rural, remote and urban communities with affordable and accessible computer and Internet services, 197 communities were identified to be provided with network coverage under the **NTELESA II** telecommunication project. The project was focused on supplying and maintaining network infrastructure in rural areas of Botswana. The project was completed in 2011.

The communities were grouped using 'Logical Zones' based on geography and population. The logical zones have further been divided into regional networks or "underserved areas" to provide an economy of scale; the larger the area the greater the business that will allow operators to prosper and grow. This consolidation of logical zones resulted in the creation of 4 underserved areas. The three mobile telephone service providers; Mascom, Orange and Botswana Telecommunications Cooperation [beMobile] were awarded tenders in the four underserved areas (regional networks).

97% of the population have access to voice communications, 70% of the population has access to 3G including the rural areas.

2.3.2 Kitsong Centers

The Rural Telecommunications Programme targets provision of essential infrastructure services in rural areas. Services include Internet lines, telephones and secretariat services.

Kitsong Centres were initially set up in 2006/2007 as community access centres as one of the Maitlamo ICT Policy Initiatives. Initially Kitsong Centres were set up in each community but there

are now c. 149 Kitsong centres across the country. These community access centres provide local community access to computers, fax, voice services and internet access as well as a range of on-line information including: local and community information, business information services, government information and services such as school registration, birth certificates, livestock tracking and passport applications. There are also Botswana Postal Services Telecentres and private telecentres which have been established as Community initiatives.

Mascom Wireless Botswana, one of the PTO's which partnered with government for Nteletsa II project, has adopted the Kitsong Centre model to enhance their business by incorporating it under their corporate social responsibility program. While Mascom had a contractual obligation to deliver 41 Kitsong centres, it has actually installed more than a hundred to date.

2.3.3 Thuto Net

The Thuto Net program was an expansive project that incorporates the **Schools Connectivity Initiative**, to link all Botswanan secondary schools to the Internet. All secondary schools in Botswana now have computer laboratories with an average of 15 - 20 computers. This initiative was aimed at reducing literacy gaps between students in urban schools and rural schools. To fast track the program, the Department responsible for laying infrastructure worked closely with the Department of Education to train teachers on using ICT as a classroom tool.

All public secondary, colleges and departments are now connected to the Government Data Networks; 80 Secondary schools are now using Wi-Fi networks and 62 of 239 secondary computer labs have been upgraded in recent years.

2.3.4 Government-On-Line

The Government of Botswana undertook major service delivery reform programmes aimed at improving service quality. A government web portal with information and e-services was developed to be customer focused making the organizational structure of government more transparent to citizens and business. Some of the Government Ministries have Call Centres for customers to submit and enquire about services through Toll-Free numbers. Call centres provides basic information and services and information about the Ministry and use toll free phones.

The Botswana eGovernment initiative focused on transformation and not just automation. eServices include:

- Mobile-notification include: Drivers Licence expiry notification service, Vehicle flagging and Registration Renewal, Agriculture Business Imports ban notification, Health and HIV & AIDS notifications, Member of Parliament meeting etc
- Cattle brand collection and expiry notification service, Ministry of Agriculture, Internal Funding
- Passport notification services, Ministry of Labour and Home Affairs, Internal Funding
- National Identity notification services, Ministry of Labour and Home Affairs, Internal Funding

- Company Registration Name search feature: Ministry of Trade & Industry, Internally Funded
- Trade Permits & License, Ministry of Trade & Industry, Internally Funding

The Ministry of Agriculture developed a Livestock Identification and Trace-back System to maintain a record of all the cattle in the country, and also track the exposure level of each animal to contagious diseases. The system uses data from other Government department like the National citizen identification system for identifying cattle owners.

Ministry of Education and Skills Development provides access to examination results via mobile phone.

2.3.5 Botswana Telecommunications Corporation (BTC) Privatisation

In 2012 the Government of Botswana embarked on the privatisation of Botswana Telecommunications Corporation (BTC), the incumbent fixed line telecoms operator, which was due to be completed by end of 2014. The company was established in 1980 to provide, develop, operate and manage Botswana's national and international telecommunications services. BTC is a parastatal in which the Botswana government holds 100% equity. BTC was the only telecommunications provider in Botswana until 1996 when an amendment of the Telecommunication Act removed the monopoly of BTC and allowed indirect competition from two cellular companies, Mascom Wireless and Vista Communications (now Orange). Botswana Telecommunications Corporation (BTC) - Implementation of BTC's privatisation commenced immediately after Cabinet approved of a privatisation strategy in June 2006.

The implementation of BTC's privatisation commenced in 2010. Botswana Fibre Networks (BOFINET) is wholly owned by the government and serves as a wholesale provider of national and international telecommunication infrastructure. BoFiNet's mandate is to provide and operate a world-class telecommunications backbone network infrastructure, which will drive connectivity and economic growth. BoFiNet has over 8,000km of fibre laid around the country. This fibre cable connects cities, towns and villages across this large country.

The national backbone (Trans Kalahari optic fibre network and Gaborone – Francistown loop) is not included in the privatisation as this is transferred to BoFiNet and the Government will continue to deliver developmental programmes such as the rural telecommunications programme (Nteletsa).

During Phase 2 BTC Ltd was separated into two entities - BTC (retail) and BoFiNet (wholesale) and the following assets were transferred to BoFiNet:

- All local and national access dark fibres systems
- The newly deployed Dense Wave Division Multiplex (DWDM) system fibre and associated active electronic equipment
- The East African Sea System (EASSY) and West African Cable System (WACS)

BTC launched its IPO in November 2014, whereby the Government of Botswana offered 49% of BTC shares (44% can be bought by individual investors and local firms and 5% is retained for an

Employee Share Ownership Programme). The Government planned that the finance raised will support BTC's current network expansion plans.

2.3.6 Support for Entrepreneurship (including Botswana Innovation Hub)

While there are both public and private sector programs promoting and supporting Entrepreneurship in Botswana, the flagship government program is known as the Botswana Innovation Hub. Established on a 57 hectare site near the international airport and Diamond Technology Park in Gaborone, the mission of the Botswana Innovation Hub is to support diversification of the Botswanan economy by establishing and operating Botswana's first Science and Technology Park. The objective is to attract foreign direct investment (particularly technology) and support entrepreneurial start-ups as well as supporting growth of existing local companies.

The focus of BIH is on promoting growth in the following economic sectors

- Information and Communications Technology and ICT enabled services
- Energy and Environment (Clean Technology)
- Mining Technologies and Beneficiation
- Indigenous Knowledge Systems (IKS)
- Biotechnology

The BIH has been responsible for hosting a number of programs and centres supporting entrepreneurship across these key sectors. Sector specific programs include the Mining Technology Entrepreneurship (MTech) Centre and Cleantech Centre, while more broadly focused initiatives hosted by BIH include the Microsoft Innovation Centre, First Steps Venture Centre (FSVC) and RLabs Botswana (in partnership with BIH and the Finnish Government regional SAIS Program).

Other key actors in supporting entrepreneurial activity include the University of Botswana, which hosts the Global Business Labs Botswana, the Centre for Scientific Research, Indigenous Knowledge and Innovation (CesRIKi) and the DESIS Lab, and the Botswana Technology Center (BOTEC), which established the National Technology Business Incubator (NTEBI).

Established in 1979 and a parastatal of the Ministry of Communications, Science and Technology, the Botswana Technology Center (BOTEC) has a particular focus on energy related innovation.

Another key governmental actor supporting innovation is the Botswana Institute for Technology Research and Innovation (BITRI, www.bitri.co.bw), a parastatal under the Ministry of Tertiary Education, Research, Science and Technology. Established in 2012, the mandate of BITRI is to identify, develop and/or adapt appropriate technology solutions that provides sustainable innovative solutions through co-creation and collaboration in line with national priorities and needs of Botswana. BITRI complements the role of the BIH with its focus on Natural Resources and Materials (including building materials science, climate change and nanomaterials) and Technologies (including electronics and communications, information systems and technology and energy).

Botswana Innovation Hub is the focal point in the Southern African Innovation Support Programme (SAIS 2), which is supported by the Ministry of Foreign Affairs Finland from 2017 - 2021. The SAIS2 Innovation Fund provides grants for locally implemented projects with partners from the beneficiary countries (Botswana, Namibia, South Africa, Tanzania and Zambia). BIH is a member of the SAIS2 Connected Hubs.

2.3.7 Broadband Strategy & Universal Access and Services

The development of a five-year Broadband strategy was approved and is now under implementation, facilitating broadband connectivity countrywide.

The Government of Botswana, through the Ministry of Transport and Communications, had identified broadband as an area requiring special attention to enable of economic growth as being one of the top priorities within the National ICT Policy. The objective is to formulate a strategy that will enable the Botswana Government to transform the economy and society through the adoption and utilization of broadband services. The broadband services should meet the following criteria:

1. Nationwide availability and access to all
2. Open Access.
3. Scalability.
4. Affordability.
5. User and Consumer friendliness.
6. Choice of broadband services
7. Making Botswana a regional ICT Hub.

It is planned that the Kitsong Centres will increase day-to-day access to broadband services.

The Universal Access and Services policy has been finalised. The vision of the Universal Access and Services Policy is that all Botswana will have Universal service with affordable voice communications and access to Internet and ICT services, regardless of their location within the country. BOCRA has established the Universal Access and Service Fund (UASF) as a separate entity specifically to fund and implement the UASF programs and projects. The UASF has commenced three major projects in three regions of the country and these are:. Computerisation schools, Internet connectivity to all the schools with high speed broadband internet of 5Mbps and Upgrading of base stations from 2G to 3G or better.

2.3.8 Cyber Security

Botswana conducted a Cybersecurity readiness assessment with assistance of the ITU in 2012. In 2015 the MTC sourced the Technical support from CTO (funded by UK Government) to develop the National Cybersecurity Strategy (NCS).

The NCS is a high-level framework for securing cyberspace in Botswana. It set out the national objectives and clarified stakeholders' roles and responsibilities. The government through its NDP 11 identifies secure cyber space as a key success factor for sustainable economic growth. The National Cyber Security Strategy is at the final stage of approval. Cybersecurity for all by 2022 and beyond (Vision), was conducted in 2012 in partnership with ITU International Multilateral Partnership Against Cyber Threats (IMPACT).

Botswana has some policies and legislations related to cyber space such as; 2007 Cybercrime and Computer related Act; 2012 Communications Regulatory Authority Act; 2014 Electronic Communications and Transaction Act; Electronic Records and Evidence Act; and 2007 Maitlamo Policy.

Botswana is one of the beneficiary countries in the Digital4Development Cyber Resilience for Development project. This project aims to strengthen Cybersecurity Policy, Strategical, and Coordination Frameworks, increase Cybersecurity Incident Response Capabilities and foster networks of cyber expertise and cooperation. During Q4 2018 a project coordinator has been set up in Botswana with responsibility for supporting the development of detailed action plans to deliver National Cyber Security Strategies. They are also planning project launch events due in early 2019.

2.3.9 Pan African eNetwork Project

Botswana is a participant in the Pan African e-Network project, which focused on connecting African countries as one network through satellite and fibre optic links for providing electronic and knowledge connectivity. The network primarily provides effective communication and connectivity. It also provides tele-education, tele-medicine and VVIP service. In total the project aimed to inter-connect Universities, Learning Centres, Super Specialty Hospitals and Remote Hospitals in the membership of the e-Network project. Botswana identified 3 Very Small Aperture Terminals [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 (Nyangabgwe Referral Hospital in the North part of the country and a VVIP Location at the Office of the President.

2.4 National ICT Research Capacity and Priorities for Cooperation

2.4.1 National ICT Research Priorities

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.

2.4.2 National ICT Research Capacity

The following universities and research centres in Botswana are undertaking ICT-related initiatives:

- **University of Botswana, Dept of Computer Science**¹⁶⁰ - Advance Computing; Information Management; Components and Systems; eInfrastructures
- University of Botswana, Harry Oppenheimer Okavango Research Centre¹⁶¹
- **University of Botswana, School of Medicine** – Health/ eHealth Sciences; eInfrastructures; Simulations
- **Botswana International University of Science and Technology (BIUST)**¹⁶² – CITE Department – ICT for Healthcare, Technology-enhanced Learning, Resource efficiency; MEGE Department – Transport, Energy; Applied Sciences – Cyber Security; Earth & Environmental Sciences – Embedded Systems, Wireless Communications, Robotics, Software Simulation
- **Limkokwing University of Creative Technology**¹⁶³ - Faculty of ICT – Technology-enhanced learning, Advanced computing architecture, Future Internet (Interactive multimedia, wireless communication)
- **Botho University**¹⁶⁴ - Faculty of Computing – Cloud Computing, Data mining in Education, Grid Computing, Robotics, Machine Learning, Cyber Security
- **Botswana Accounting College** – Department of Computing and Information Systems - Data analytics for Health, Technology-enhanced learning, cyber security optimisation, content access and analytics
- **Botswana National Veterinary Laboratory Research**
- **Botswana National Food Research Centre (NAFTEC)**
- **Botswana Institute of Technology Research & Innovation (BITRI)**
- **Department of Research Science & Technology (DRST)**

2.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and inputs provided during the IST-Africa Horizon 2020 Training Workshop in November 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Partners include
eHealth	University of Botswana (School of Medicine); Botswana International University of Science and Technology (CITE Department); Botswana Accounting College (Department of Computing and Information Systems)
eAgriculture	University of Botswana; Botswana National Food Research Centre, Botswana University of Agriculture and Natural Resources, AgriBusiness Botswana

¹⁶⁰ http://www.ub.bw/learning_progs.cfm?pid=587

¹⁶¹ <http://www.orc.ub.bw/>

¹⁶² <http://www.biust.ac.bw/>

¹⁶³ <http://www.limkokwing.net/botswana/>

¹⁶⁴ <http://www.bothocollege.ac.bw/>

Technology-enhanced Learning	Limkokwing University of Creative Technology (Faculty of ICT); Botswana International University of Science and Technology (CITE Department)
Energy	Botswana International University of Science and Technology (MEGE Department)
Sustainable Development and Climate Change	Botswana International University of Science and Technology (MEGE Department)

2.4.3 Mapping to H2020 Themes

Based on an initial consultation process including engagement in the IST-Africa Horizon 2020 Training Workshop in November 2016, each University has identified their areas of research expertise and track record and has been encouraged to develop an organisational profile. A summary of these findings are provided below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	University of Botswana, Dept of Computer Science- Smart Embedded Components and Systems Botswana International University of Science and Technology (BIUST), Earth & Environmental Sciences – Embedded Systems
Advanced Computing	University of Botswana, Computer Science Dept - Processor and System Architecture Limkokwing University of Creative Technology - Faculty of ICT – Processor and System Architecture, Simulation Software
Future Internet	University of Botswana Computer Science Dept - Networks Limkokwing University of Creative Technology - Faculty of ICT – Interactive Multimedia, Wireless Communications Botswana International University of Science and Technology (BIUST) - Earth & Environmental Sciences - Wireless Communications Botho University - Faculty of Computing – Cloud Computing, Grid Computing
Content Technologies & Information Management	Limkokwing University of Creative Technology - Faculty of ICT - Technologies for Language, Learning, Interaction, Digital Preservation, Content Access and Analytics; Big Data Technologies' Advanced Data Mining, Machine Learning, Statistical Analysis and Visual Computing Botswana International University of Science and Technology (BIUST) – CITE Department – Technology- enhanced Learning Botho University - Faculty of Computing – Machine

	<p>Learning</p> <p>Botswana Accounting College – Department of Computing and Information Systems - Technology-enhanced learning, content access and analytics</p>
Robotics	<p>Botswana International University of Science and Technology (BIUST) - Earth & Environmental Sciences – Robotics</p> <p>Botho University - Faculty of Computing – Robotics</p>

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>University of Botswana, School of Medicine - Health/eHealth Sciences</p> <p>Botswana International University of Science and Technology (BIUST) – CITE Department – ICT for Healthcare</p> <p>Botswana Accounting College – Department of Computing and Information Systems - Data analytics for Health</p>
Food Security, Sustainable Agriculture	<p>Botswana National Veterinary Laboratory Research on Animal Health: Epidemiology & control of foot and mouth disease, Causes of infertility in cattle, sheep & goats</p> <p>Research on Food Safety: Human causing disease bacteria in meat and milk, chemical & antibiotic residues in meat</p> <p>Research on Public Health - Epidemiology & control of zoonotic diseases (e.g. rabies, anthrax) at the human/animal-wildlife interface</p> <p>Botswana National Food Research Centre – Food Technology; Food Biochemistry; Food Microbiology & Biotech; Nutrition & Dietetics; Extension & Training</p> <p>Botswana University of Agriculture and Natural Resources (Department of Animal Sciences and production, Department of Engineering, Department of Economics and Extension)</p>
Energy	Botswana International University of Science and Technology (BIUST) –MEGE Department – Energy
Transport	Botswana International University of Science and Technology (BIUST) –MEGE Department – Transport
Secure Societies	<p>Botswana International University of Science and Technology (BIUST) –Applied Sciences – Cyber Security</p> <p>Botho University - Faculty of Computing – Cyber Security</p>

Level of Research Maturity

Botswana is currently trying to diversify its economy and attracting 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.

Participation in 9 FP7 projects and other International programmes such as the Southern Africa Innovation Support Programme (SAIS) (2011 – 15) and SAIS II (2017 - 2019) funded by Ministry of Foreign Affairs of Finland will also assist in building international partnerships.

Up to September 2018, Botswana organisations are involved in 3 Horizon 2020 projects with research funding of over €250,000 across a range of thematic areas:

- FOOD, H2020-SFS-2014-1 - **PROIntensAfrica** (CSA - Coordination & support action) - Centre for Coordination of Agricultural Research and Development for Southern Africa
- H2020-WATER-2015 - **AfriAlliance** (CSA - Coordination & support action) - Waternet Trust
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA - Coordination & support action) - Ministry of Transport and Communications

2.5 Innovation Spaces

The Government of Botswana decided at an early stage that it is necessary to actively support entrepreneurship as an important contributor to diversifying the economy. The **Local Enterprise Authority** (LEA)¹⁶⁵ was established in 2004 to support SMEs, provide training, mentoring, technology adaptation and support services. The LEA has four incubators in different locations around the country; Pilane Multi sector Incubator (2009), Leather Industries Incubator (2010), Francistown Industrial Business Incubator (2011) and Glen Valley Horticulture Incubator (2011).

The **Botswana Innovation Hub** (BIH)¹⁶⁶ was conceived in 2008 within the Botswana Excellence Strategy to support economic diversification, job creation and transition towards a knowledge-economy by encouraging inward investment, research and training in the areas of ICT, Bio-Technology, Energy and Mineral Technology. Focal Sectors include Clean Energy, Solar Energy, Water Technologies, Sustainability, Coal Utilisation and Waste Management. ICT priorities include Innovation, Application and Services, Infrastructure and Priorities. Programmes include broader focused initiatives including the ICT Technology Cluster and the First Steps Venture Centre, as well

¹⁶⁵ www.lea.co.bw

¹⁶⁶ <http://www.bih.co.bw/>

as sector-oriented initiatives including the Mining Technology Entrepreneurship Centre (MTech Centre) and Cleantech Centre.

BIH has received support through the Finnish Government supported regional Southern African Innovation Support (SAIS)¹⁶⁷ Programme to establish a Global Business Lab¹⁶⁸ and Technology Transfer Office within the University of Botswana; develop a Demand Driven Supply Chain Business Incubation Model; and address youth unemployment and local communities through Living Labs and Training (RLabs Botswana). BIH is also a partner in Southern African Innovation Support (SAIS) Programme 2, 2017 - 2020.

BIH is located close to the airport and offers services in the form of office space, land, state of the art telecommunications services, technology transfer services and entrepreneurship development. The Government of Botswana has put tax incentives in place to encourage Foreign Direct Investment.

The University of Botswana is hosting three Innovation Spaces; Global Business Labs Botswana¹⁶⁹ (2013); Centre for Scientific Research, Indigenous Knowledge and Innovation (cESIKi) and the DESIS Lab¹⁷⁰.

Global Business Labs (GBL) is a Swedish based not-for-profit focused on early stage development, which in recent years has established partner hosted operations in Namibia, Botswana and Uganda.

Part of the Okavango Research Institute at UB, CesriKi is an interdisciplinary and science focused research centre embracing the basic and applied sciences of Indigenous Knowledge, with a particular focus on participatory research, and documentation, education and awareness, and development efforts in Health, Food systems, Agriculture and Environmental management.

The DESIS Lab (Design for Social Innovation and Sustainability) at University of Botswana is part of a partnership of universities including Cape Peninsula University of Technology (South Africa), University of Nairobi (Kenya), Makerere University (Uganda), Rio de Janeiro Federal University (Brazil) and Politecnico di Milano (Italy).

¹⁶⁷ <http://www.saisprogramme.com/overview/>

¹⁶⁸ <http://globalbusinesslabs.com/office/botswana/>

¹⁶⁹ www.saisprogramme.com/global-business-lab-sets-up-shop-in-botswana-and-namibia/

¹⁷⁰ www.desis-network.org/content/university-botswana-desis-lab

3. REPUBLIC OF BURUNDI

3.1 Introduction

The Republic of Burundi is situated in Central Africa, sharing boundaries with Democratic Republic of the Congo, Rwanda and Tanzania. It is a landlocked country and has a surface area of 27,830 sq km, made up of 17 provinces. The population is estimated at 11.844 million inhabitants (July 2018 est. CIA World FactBook) with a literacy rate of 85.6%. 52% of the total population is between 15 and 64 years of age. The capital city is Bujumbura with a population of 899,000 (2018). Kirundi is the national language with French as the official language. Other languages spoken are Swahili and English.



Burundi joined the East African Community to improve regional trade ties. The economy is predominantly agricultural with primary exports of coffee and tea. Burundi is currently dependent on bilateral and multilateral aid.

In relation to Communications, there were 22,758 fixed line subscribers, 6.151 million mobile phone subscribers and 877,703 internet subscribers as at 30 September 2018 with mobile penetration of 51.53% and internet penetration of 7.4% according to Agence de Regulation et del Controle des Telecom (ARCT). There are five ISPs.

In terms of ICT Infrastructure, the Government of Burundi in cooperation with the World Bank has undertaken a 13,000 kilometre fibre-optic project to cover Bujumbura, 17 provinces and the borders. This will help reduce communication costs in Burundi.

The regulator is Agence de Regulation et de Controle des Telecommunications (ARCT). Mobile operators include Econet Leo, Onatel Burundi, Lacell SU and Vietnam's Viettel Telecom. Internet Service Providers include: Cbinet; Spidernet; USAN; Lamiwireless and NT Global. Internet Services leverage a mix of VSAT, fibre optic, WiMax and ASDL. Two mobile operators in Burundi launched 3G broadband in the expectation of reduced Internet access costs.

There are 7 public institutions of Higher Education and 42 private institutions of Higher Education.

3.2 ICT Background

Burundi considers ICT to be an important enabler that can facilitate developments and job opportunities in the country. The Government of Burundi is committed to encouraging the integration of ICT in all spheres of society. The telecommunications sector is liberalised but Internet

access is predominantly restricted to public points of access in cyber cafes in the capital, Bujumbura.

The National eGovernment Strategy was adopted in 2009 and the Executive Secretary for ICT (SETIC) is responsible for coordinating this activity.

The National ICT Development Policy was jointly formulated by the Government and UNDP in October 2000 and adopted in 2004. Subsequently the Government approached UNECA to work with them to develop and fund an ICT action plan for the period 2007 – 2011. UNESCO undertook a survey of Higher Education institutions in 2008.

The National ICT Policy was revised and adopted in 2011 to make it more compliant with the regional framework and more in line with technology convergence. It has ten pillars including:

- Capacity building
- Enhancement of the Legal and Regulatory Environment
- Promotion of ICT infrastructure
- E-government, e-Governance and Online Administration.
- ICT and Economic development
- ICT and Social Development
- Rural Connectivity and Universal Access
- ICT Research and Innovation
- Electronic Transactions and Cybersecurity
- Local and Regional Content Development

The Government of Burundi has led several activities in relation to the use of ICT in the service of the socio-economic development and Good Governance under the responsibility of the National Committee. These activities include: development of the National Policy in STI, launch of an optical fibre project, plans to provide computers in the Higher Education system, a policy for free changes when importing ICT equipment and the development of partners in ICT Networking (such as participation in the IST-Africa Initiative).

A National Policy for Science, Technology and Innovation (STI) was developed and adopted in June 2011. This policy outlines various actions that the Government intends to take in order to ensure that R&D and Innovation activities are adequately funded. Its implementation framework for 2014 – 2018 was validated in July 2013. The STI Policy was officially launched on 08 August 2014 by H.E. Hon. Dr Ir Gervais Rufyikiri, Second Deputy President of the Republic of Burundi.

The Decree to set up a National Council or Commission for Science, Technology and Innovation was signed on 16 July 2014. Currently there is no dedicated mechanism to fund R&D and Innovation at a national level.

The World Bank supported the National Backbone system to link the provinces. The design phase commenced in early 2008. The first phase of the fibre optic project (1,000km covering nine of the 17 provinces) was officially launched by President Pierre Nkurunziza on 21 January 2014. According to ARCT 17 of the 18 provinces in Burundi are now interconnected via the national fibre-optic backbone, which extends over 1,254kms. ARCT reported that 50 public institutions are connected through the Government Communication system project. Mobile phone companies and Internet Service Providers are now on the BBS network. The following commercial banks are now offering mobile services - BANCOBU MCASH, IBBMCB BANK, FONECASH, KCB MOBI BANK, ECOCASH, B-WEB, B-PHONE.

3.3 Current ICT Initiatives and Projects

ICT Initiatives are primarily focused on eInfrastructure and eGovernment. A metropolitan area network has been set up in Bujumbura, Gitega Province and Ngozi Province. Telecentre is facilitating Internet access within secondary schools.

3.3.1 National Projects leveraging ICT

The Ministry of Communications is supporting the COMGOV project, which includes a data and application server, website and government mail server. The national backbone provides internet connectivity, data transmission, unified communications for email and video conferencing, mobile backhaul, cloud services, Internet Exchange point and internet IPTV.

The Ministry of Health is leveraging ICT to support the implementation of the national health plan (PNDIS 2015 - 2019). It includes an eHealth Enterprise Architecture for Burundi and implementation plan. Over the coming five to ten years it aims to establish a professional health datacentre, create an effective intranet between health facilities, deploy a central warehouse for aggregated health data, set up an eHealth National Steering Committee and support capacity building in eHealth.

The Ministry of Agriculture has prepared a website to support easier data exchange in relation to agriculture, livestock farming and environmental issues. Projects are ongoing to support information feeds to inform farmers on prices and agriculture production issues and to create an interactive irrigation map.

3.3.2 Broadband Wireless Network

ITU implemented the Broadband Wireless Network Project in Burundi. The main outputs of this project include: Deployment of wireless broadband infrastructure in Burundi; Development of ICT applications; Training local experts on the operation of deployed wireless communication networks; Development of national ICT broadband network plans for Burundi that will deliver free or low cost digital access for schools and hospitals, and for underserved populations in rural and remote areas; Development of an impact assessment report and reporting. This project commenced in 2009 and finished in December 2014.

3.3.3 Establishment of National CIRT

ITU implemented the establishment of the National Computer Incident Response Team (CIRT) in Burundi. This project aimed to assist the Government of Burundi in building and deploying the technical capabilities and training required to establish the national CIRT. This will also assist in developing national cybersecurity capacity. This project ran from January 2013 to February 2015.

3.3.4 Regional Communications Infrastructure Project

This regional project focused on Burundi, Kenya and Madagascar to support the enabling environment, connectivity and preparation for eGovernment applications. This project supported by World Bank and partners and implemented by Ministère des Télécommunications, de l'Information, de la Communication et des Relations avec le Parlement commenced in 2007. The project in Burundi was restructured in April 2013 with the project life extended until April 2014.

3.3.5 Burundi Education and Research Network (BERNET)

The ICT Executive Secretariat (SETIC) sponsored the creation of Burundi NREN through the establishment of a physical Last Mile connection to 15 public and private higher education institutions, which form the core members of BERNET. SETIC has also secured the Association's membership in UbuntuNetAlliance and acquired a block of IP addresses from Afrinic. BERNET is up and running as a non-profit Association since 2014 governed by an Executive Committee supported by an in-house Technical Team. To date fifteen universities are connected to BERNET leveraging discounted pricing put in place with Burundi Backbone System Company. However, most institutions have access to limited connectivity compared to the number of users within the institution. In 2016 BERNET was accredited as an Internet Service Provider and are now connecting some government institutions. Through UbuntuNet Alliance BERNET has the potential to benefit from the Africa Connect 2 project but to date the matching funding at national level has not been secured.

3.4 National ICT Research Capacity and Priorities for Cooperation

3.4.1 National Priorities

In accordance with Burundi's National STI Policy (2011) and its Implementation Action Plan 2014 - 2018, the following critical strategic sectors have been identified:

- Agro-food Technology
- Medical Science
- Energy, Mining and Transport
- Water, Environment and Desertification
- Biotechnology and Indigenous Knowledge

- Materials Science, Engineering and Industries
- ICT, Spatial Science and Mathematics
- Humanities and Social Science

National ICT Research Priorities include:

- ICT Infrastructure Development including fibre optic to provide high speed, high bandwidth connectivity at a more cost effective cost, thus supporting the increase in internet and mobile penetration in Burundi
- Application of ICT in Education – Technology-enhanced learning and capacity building is a priority both for Secondary Schools, Higher Education Institutions and TVET
- Application of ICT in Governmental Services – priority areas include: Immigration, Biometric ID, Land management (GIS) and Taxation

3.4.2 National Research Capacity

The following universities and research centers in Burundi are providing ICT/Engineering Courses and /or undertaking ICT-related initiatives:

- **Université du Burundi** (Bujumbura)
 - Departments include: ICT Department, Polytechnics Dept, Civil Engineering Dept
 - Research areas include: Components and Systems, Advanced Computing, Technology-enhanced Learning, Health (Faculty of Medicine), Sustainable Agriculture (Faculty of Agronomy and Bioengineering)
- **Université Lumière de Bujumbura**¹⁷¹
 - Departments include: Faculté de Communication & Faculté d'Informatique de gestion;
 - Research areas include: Advanced Computing, Technology-enhanced learning
- **Université Espoir d'Afrique**¹⁷²
 - Departments include: Faculté des Lettres et des Sciences (Département d'informatique, option Informatique et système de gestion de l'information & Département de la Communication); Faculté d'ingénierie et de Technologie (Département d'Ingénierie en génie et gestion des télécommunications);
 - Research areas include Public Health (Faculty of Medicine)
- **Université de Ngozi** (Bujumbura)
 - Departments include: Faculty of Maths - Informatique; Faculty of Medicine; Faculty of Agriculture

¹⁷¹ <http://ulbu.bi/>

¹⁷² <http://www.hopeafricauniversity.org/>

- Research areas include: Components and Systems, Technology-enhanced Learning, Health Sciences (Faculty of Medicine); Agriculture and Food Security
- **INTELEMATIQUE** (Bujumbura)
 - Departments include: Informatics Engineering, Software Engineering
 - Research areas include: Component and Systems, Advanced Computing, Technology-enhanced learning
- **Université des Grands Lacs**¹⁷³
 - Departments include: Faculté d'Informatique
- **Université du lac Tanganyika**
 - Departments include: Informatics
- **Université Sagesse d'Afrique**
 - Departments include: Informatics
- **Université Polytechnique de Gitega**
 - Departments include: Faculty of ICT
- **International University of Equator**
 - Departments include: Department of ICT
- **Institut Supérieur des Technologies** (Bujumbura)
 - Departments include: Maintenance Informatics
- **Institut Supérieur Professionnel du MENVC**
 - Département d'Informatique de maintenance
- **Institut Supérieur d'Enseignement Technique de Rumonge**
 - Département d'Informatique de Gestion et de maintenance
- **Grand Séminaire de Burasira** (Burasira, Ngozi)
 - Departments include: Management informatics
- **Université Martin Luther King**
 - Departments include: Management informatics, Logistic and Computer Maintenance
- **Ecole Nationale d'Administration**
 - Departments include: Informatics
- **Institut Supérieur de Développement (ISD)** (Bujumbura)
 - Departments include: Administration et Sécurité des Réseaux, Computer Maintenance

¹⁷³ <http://www.ulpgl.net/>

- **Institut Supérieur de gestion et d'Informatique**
 - Département des Technologies et de la Communication
- **Institut Supérieur des Techniques de gestion**
 - Département d'Informatique de gestion

In total there are 49 Institutions of Higher Education in Burundi with over 55,000 students enrolled.

3.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and the IST-Africa H2020 Training Workshop in Bujumbura in November 2014, the following thematic areas were considered to be important in the context of ICT-39: eHealth; eAgriculture; Climate action; Environment and Energy. It was noted that the focus areas under the National Policy on Scientific Research and Technological Innovation (2014) is well aligned with Societal Challenges under Horizon 2020.

Thematic Areas	Partners include
eHealth	University of Burundi; National Institute of Public Health; East Africa Community (EAC) Centre of Excellence in Public Health Training; Université de Ngozi; Université Espoir d'Afrique
eAgriculture	University of Burundi; Université de Ngozi; National Center for Food Technology (CNTA); Institute of Agronomic Sciences (ISABU)
Energy	University of Burundi; REGIDESO; ONATOUR

3.4.4 Mapping to H2020 Themes

Horizon 2020 Industrial Leadership	Institution, Relevant Dept.
Components and Systems	University of Burundi (ICT Department, Polytechnics Dept, Civil Engineering Dept) Université Lumière de Bujumbura (Informatics, Civil Engineering Dept) INTELEMATIQUE (informatics Dept) Université de Ngozi (Informatics Dept)
Advanced Computing	University of Burundi (ICT Department, Polytechnics Dept, Civil Engineering Dept) Université Lumière de Bujumbura (Informatics Dept) Université de Ngozi (Informatics Dept)
Future Internet	Executive Secretariat for ICT (SETIC)
Content Technologies & Information Management	Executive Secretariat for ICT (SETIC) University of Burundi (ICT Department, Polytechnics Dept, Civil Engineering Dept)

	Université de Ngozi (Informatics Dept) Université Lumière de Bujumbura (Informatics Dept, Civil Engineering Dept) INITELEMATIQUE (Informatics Dept)
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Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>University of Burundi, Faculty of Medicine: Malaria, HIV SIDA, Neglected tropical diseases, Telemedicine application; Faculty of Sciences: Phytochemicals & Traditional medicine</p> <p>National Institute of Public Health (INSP): Malaria, HIV SIDA, Neglected tropical diseases</p> <p>East Africa Community (EAC) Centre of Excellence in Public Health Training</p> <p>Université de Ngozi, Health Science Institute/Faculty: Malaria, HIV SIDA, Neglected tropical diseases</p> <p>Université Espoir d'Afrique, Faculty of Medicine: Public health</p>
Food Security, Sustainable Agriculture	<p>University of Burundi, (Faculty of Agronomy and BioEngineering): edible fungi, improvement of rice production, tissue culture; IRRI-ESA: International Rice Research Institute for Eastern, Southern and Central Africa</p> <p>National Center for Food Technology (CNTA) (Ministry of Agriculture and Livestock) - Research and development of food technology and the transfer and dissemination of these technologies to small enterprises.</p> <p>Institute of Agronomic Sciences (ISABU) (Ministry of Agriculture and Livestock) - focus on maize, rice, cassava, potatoes, livestock etc.</p> <p>Université de Ngozi, CERADER: Vegetable seeds multiplying; AGROBIOTECH: banana tissue culture</p>
Energy	<p>REGIDESO (water and hydropower supply)</p> <p>ONATOUR (Peat Supply)</p> <p>University of Burundi (Renewable Energy)</p>

Level of Research Maturity

Burundi is slowly building up the institutions and infrastructure following twelve years of crisis up to 2005. The general level of research maturity in Burundi is limited, primarily due to lack of international exposure, developing infrastructure and limited donor engagement. IST-Africa has assisted greatly in this regard, by providing necessary resources, facilitating exchange of experiences with both Europe and Africa, focusing international attention on Information Society and

ICT related challenges and opportunities in Burundi and providing opportunities to engage with research stakeholders internationally. Complementary activities include the launch of an optical fibre project, plans to invest in infrastructure and computers in the Higher Education system, a policy for free charges when importing ICT equipment and the development of partners in ICT Networking (such as participation in the IST-Africa Initiative).

One of the key challenges is the small number of institutions actively engaging in multidisciplinary research. While the current primary focus is on technology adoption and developing applications, there is a strong policy focus on strengthening research capacity within the country, and especially in facilitating the continued development of post-graduate programmes and involvement in cross-border research. The recent establishment of the National Research and Education Network (BERNET) is very positive. There is now a much higher level of awareness of pan-African and international ideas of what level of research maturity is required and a greater focus on the development of research results with the potential to achieve sustainable socio-economic impact.

Up to September 2018, Burundi is involved in 2 Horizon 2020 projects with research funding of over €60,000 across a range of thematic areas:

- SOCIETY, H2020-INT-INCO-2014 - **RINEA** (CSA - Coordination & support action) - Ministere De L'Enseignement Superiet de la Recherche Scientifique
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA - Coordination & support action) - Ministere De L'Enseignement Superiet de la Recherche Scientifique

3.5 Innovation Spaces

The *Burundi Business Incubator*¹⁷⁴ was set up in 2010 and has received financial and technical support through USAID and the Dutch Embassy to supporting training programmes and local capacity building. It provides both pre-incubation and incubation services. It provides pre-incubation, coaching, mentoring and business networks for start up companies. BBIN cooperated with SPARK from June 2017 to January 2018, with support from UNDP, to support young people to set up SMES and community action groups in Burundi.

During 2013 the Segal Family Foundation piloted the *Social Impact Incubator*¹⁷⁵ in Bujumbura as a capacity building programme and the first cohort graduated in October 2013. During 2014 in partnership with CARE International Burundi, the Social Impact Incubator took in another cohort of 24 incubates. Over 60 organisations participated in SII Burundi during 2013 - 2015. Remote support was provided to partners from 2015.

The *UNICEF Burundi Innovation Lab* is focused around technology for development; micro-energy rural entrepreneurship models and leveraging tools and mobile-based platforms to address national

¹⁷⁴ <http://www.bbin.bi/>

¹⁷⁵ <https://www.segalfamilyfoundation.org/sii/>

challenges. *Ideas Box*¹⁷⁶ was launched in Burundi as a UNHCR initiative, focused on addressing local thematic challenges, such as energy or education, with projects prototyped and tested in UNHCR operations around the world.

Spark¹⁷⁷ is a Dutch based not-for-profit, which is focused on supporting entrepreneurship and access to higher education for students in post-conflict societies, with African offices including Liberia, Rwanda and Burundi.

Spark supported projects focused on addressing entrepreneurship development in Burundi include Agri-business Incubation Network (ABIN) Programme (focused on establishing a network of rural agribusiness incubation centres across Burundi), Agri Business Creation (ABC) programme (coaching emerging entrepreneurs through training, mentoring and business plan support) and the Entrepreneurship Development Programme (MFS II - 2011 - 2016) supported by the Dutch AGovernment and delivered in partnership with the BiD Network, which focused on promoting entrepreneurship and job creation through supporting local partners, developing partner capacity and advocating for improved business enabling environment in Kosovo, Liberia, the Palestinian Territories, Burundi and Rwanda.

¹⁷⁶ <http://innovation.unhcr.org/labs>

¹⁷⁷ <http://www.spark-online.org/>

4. REPUBLIC OF CAMEROON

4.1 Introduction

The Republic of Cameroon is situated in Central Africa, sharing boundaries with Nigeria to the west, Chad to the northeast, Central African Republic to the east, Congo, Gabon and Equatorial Guinea to the south with direct access to the Atlantic Ocean to the southwest. It is a unitary state, with a surface area of 475,442 square km, made up of ten regions subdivided into fifty-eight (58) divisions and further subdivided into 375 districts currently in the process of decentralisation. The population as at July 2018 is estimated at 24,640 million inhabitants with a literacy rate of 75% (CIA World Factbook). 54.6 percent of the total population is between 15 and 64 years of age.



Yaounde, the capital city, has a population of 3.412 million (2018) and Douala has a population of 3.656 million (2018). The official languages are English and French.

Cameroon is called Africa in miniature due to its strategic geographical location, diversified culture (over 240 tribes composed of Bantus, Semi-Bantus, Soudanians, Hamites and Semites), two main religions: Christianity and Islam, climate (tropical and humid in the south and dry in the north with two seasons), vast equatorial forest found in most African countries. Its natural resources include: Petroleum, Bauxite, iron ore, timber and hydropower.

In relation to Communications, according to July 2017 figures (CIA World FactBook), there were 699,055 fixed phone lines in use compared with 19.7 million mobile phones. There were 6.12 million Internet users as at June 2017, representing 25.0% of the population. This increase is due to the introduction of 3/4G technologies and availability of low cost smart phones at national level.

In terms of ICT Infrastructure, there is a SAT-3 marine cable inward with access points in Douala (main one), Limbe (WACS) and Kribi (ACE). There is a national backbone of over 6,000 km of fibre optic cable laid down and financed by the Chinese Government. There is a fibre optic loop in Douala and a second being laid in Yaounde. Cameroon is linked to Chad with fibre optic cable under the Central African Backbone (CAB) project. VSAT Internet is widely used. The feasibility study for establishment of a National Internet eXchange point (IXP) was financed by the World Bank. The Government of Cameroon commenced establishing of the national IXP in 2015 and the implementation phase is now completed. The two IXPs in Douala and Yaounde will be operational once the official inauguration is done during Q4 2017. There are 150 operational tele-centres, with a further 30 being put into service and 16 under construction.

There are eight public universities (University of Yaounde I; University of Douala; University of Dschang; University of Buea; University of Yaounde II; University of Ngaoundere; University of Maroua and University of Bamenda), over 180 private institutions for Higher Education and several laboratories.

4.2 ICT Background

The Republic of Cameroon has recognized that ICTs must be integrated in realising projects in various sectors (education, health, agriculture, economy, energy etc.)

In September 2005, a sectoral strategy of Posts, Telecommunications and ICT together with the sector policy statement relating thereto was finalized in a bid to influence the trends towards reducing the proportion of poverty in half by 2015 with the following objectives:

- increase the fixed (of 0.7% in 2005) and mobile (of 15% in 2005) teledensities to 30% and 50% in 2015;
- provide 20,000 villages with modern telecommunications facilities by 2015;
- multiply by 50, the number of direct and indirect jobs in the field of telecommunications and ICT by 2015.

The evaluation conducted at the end of 2015 determined that teledensity was 84% for mobile; 5% for Fixed lines and 7% Internet. For the past decade in Cameroon, more than 20,000 jobs have been created directly or indirectly in the ICT sector.

The implementation of this strategy was underpinned by the following three pillars:

- Adapting and updating the legal, regulatory and institutional framework;
- Improving service delivery in quantity, quality, and affordable;
- Increasing the use of ICT and density the industrial fabric of ICT companies

The ICT sector has undergone a process of liberalization since the promulgation of Law No. 98/014 of 14 July 1998 governing telecommunications in Cameroon.

While individual Ministries are responsible for different aspects of development, deployment and exploitation of ICTs (e.g. Ministry of Communications, Ministry of Trade, National Agency for Information and Communication Technologies – ANTIC, Ministry of Posts and Telecommunications and Telecommunications Regulatory Board, National Centre for the Development of Computer Services), the Presidency of the Republic defines and sets guidelines for National ICT policy, the Prime Ministers' Office is responsible for monitoring implementation of the ICT policy and the National Assembly has a legislative responsibility, responsible for voting ICT related laws. A committee was set up in August 2009 by a Prime Ministerial decree creating a pilot Committee for monitoring the putting in place of the National Strategy for the Development of ICT headed by the Minister of Post and Telecommunications.

Established in 2002 (Decree No 2002/92 8 April 2002) and according to Law No. 2010/013 (21 December 2010) governing electronic communications and Law No. 2010/012 (21 December 2010) related to cyber security and cyber criminality in Cameroon, the National Agency for Information and Communication Technologies (ANTIC) has the role to promote and monitor government activities in the area of ICT. Its responsibilities include: developing and monitoring the implementation of the ICT national development strategy; ensuring the harmonization of technical standards; proposing technical references in order to facilitate interoperability among information systems and regulating the sector; providing expertise to government services for design and development of their technical projects; coordinating the establishment and monitoring of Internet, Intranet and Extranet sites for the state and public institutions; contributing to the technical training of trainers for universities, high schools, colleges, teacher training colleges and primary schools; and participating in the training of the state personnel in ICTs by making recommendations on the content of the technical training and on the programmes of professional and competitive examinations. It is also responsible for the regulation, control and monitoring of activities related to the security of electronic communication networks, information systems and electronic certification on behalf of the Government of Cameroon. Following the Presidential Decree of 09 December 2011 re-organising the Cameroonian government, ANTIC reports to the Ministry of Posts and Telecommunication.

Due to insufficient consultation and coordination amongst stakeholders involved in these sectoral and ministry initiatives, ANTIC was tasked with formulating a National Policy for the Development of ICT, which implements “some provisions of the Constitution, the Investment Code, education sector laws, major guidelines of the Poverty Reduction Strategy Paper (which has been reviewed and resulting in the Growth and Employment Strategy Paper) and honour commitments made by Cameroon with regards to global poverty reduction efforts (Millennium Development Goals, Education for All, Tunis Agenda for the Information Society, etc.)”. It was validated by the Head of State, His Excellency President Paul Biya in January 2007 and it aims to provide:

- A comprehensive framework for ICT development in line with national objectives;
- A consultation and action framework for collaboration by the public sector (government) with the private sector, civil society and development partners;
- A framework for coordinating government action and external support, notably from the Digital Solidarity Fund.

It was further revised in September 2009, with the main objective to operationalise the strategic priorities identified new emphases on the consistency between programs and ICT projects and the government strategy outlined in the National Objectives Framework (NOC). The review exercise identified twelve prioritized programs based on the following seven strategic pillars retained from the National Strategy for ICT Development: (i) Building Human capacities, (ii) Improving the legal, regulatory and institutional framework, (iii) Strengthening the rule of law and sovereignty, (iv) Infrastructure development, (v) Development of social sectors through the use of ICT, (vi)

Modernizing the public service and (vii) Development of an ICT industrial sector. The revised National ICT and Telecommunication Strategy is due for adoption in Q1 2015.

According to Law No. 2010/012 (21 December 2010) related to cyber security and cyber criminality in Cameroon, ANTIC has the mandate to secure the Cameroonian cyberspace:

- Annual audit of Information systems of Institutions (public and private), which include: Telecommunication operators, Internet Service Providers (ISPs), financial institutions (Banks, micro-finances, Insurance companies, Money transfer companies and eCommerce companies)
- Under the National Public Key Infrastructure (PKI), ANTIC is the Root Certification Authority (CA) and the Government CA. This is the only PKI system legally recognised in Cameroon. The center was funded by South Korea and biometric passports are being produced.

In 2015, a new Minister of Post and Telecommunication was appointed, and a new strategy was developed known as "Cameroon Digital Economy Strategy". This strategy was adopted in late 2016 with the aim of having a digital economy by 2020.

According to the Ministry of Post and Telecommunication, after the liberalization of the Telecommunications sector, Cameroon presently has four major telephone network operators offering several services (MTN, Orange, CAMTEL & Nexttel), which influenced the increase of the number of active mobile phone subscribers. At the end of 2016, Cameroon's Telecommunication Regulatory Board estimated market penetration rates in Cameroon's telecoms sector to be: mobile (80%), Fixed/fixed-wireless (1.4%) and Internet (25%). Nexttel, Vietnam's telecom operator commenced activities in September 2014 and all the teleco operators are rolling out a 3/4G network in the country.

4.3 Current ICT Initiatives and projects

A range of initiatives have been undertaken at national level over the past number of years focused on stimulating the use of ICT as a development tool to alleviate poverty and other challenges. They include:

- Government action plan for an information and knowledge-based society by Ministry of Scientific Research and Innovation;
- Implementation of ICT development programme by Ministry of Higher Education;
- Creation of multimedia resource centres at secondary and high schools by Ministry of Secondary Education;
- Introduction of compulsory ICT related programs in Primary and Secondary schools;
- Liberalisation of the audiovisual sector by the Ministry of Communication;
- Implementation of National Governance Programme by the Prime Ministers' Office;

- Use of ICTs to manage State Personnel by Ministry of Public Service and Administrative Reform (SIGIPES), the update of the system is at the implementation phase with financial and technical help from European Union
- Computerisation of National Identity Card by the Delegation of National Security; The Government is currently analyzing the possibility of updating the system with the integration of security related technologies such as the PKI and biometriques;
- Issuing of Biometrique Passport by the Delegation of National Security;
- Computerisation of Electoral Process by Ministry of Territorial Administration and Decentralisation and
- Establishment of the national Public Key Infrastructure. Key national application secured with this system include: e-procurement (management of public contracts), e-Guce (management of the payment of importation/exportation dues at the sea port) and national social insurance system.

Initiatives supported by external funding include:

- Definition of National Information and Communication Plan (NICI Plan) by UNECA;
- UNDP Initiative on ICT Policy in Cameroon within the framework of the Second Tokyo International Conference for African Development (TICAD II);
- ITU Support for formulation of MINPOSTEL Sector Strategy;
- UNESCO Support to development of community and rural radios
- CTO support to MINPOSTEL in developing Cameroon's national cybersecurity strategy.

4.3.1 The National Electrification Project

Cameroon has experienced challenges with electricity supply resulting in power shortages even in some parts of major towns and hindering access to information and communication technologies. Despite the efforts made by the electricity corporation (AES SONEL), some towns can be without electricity for several hours or days.

A joint project to extend the road network and distribution of electricity in 400 localities in 8 regions to serve an additional 332,000 new subscribers (covering 1,5 million inhabitants) was prepared. By 2020, the Government aims to achieve a 48% countrywide electrification rate, a 75% electricity access rate in urban areas and a 20% rural electrification rate. The project started in 2010.

Additionally, in March 2015 the Minister of the Economy, Planning and Regional Development, and the General Manager of HUAWEI Technologies & Co. Limited signed a loan convention for 106 million USD (about 53 billion CFAF), to finance phase one of the solar system electrification project for 350 villages in Cameroon. This project is still ongoing as at September 2017.

Organization(s)/funding sources: Loan agreement worth 22Billion FCFA between the ADB group and Cameroon represented by the Minister of the Economy, Planning and Regional Management in Tunis.

Geographic scope and time frame: National, ongoing to end by 2035.

The projects outlined below are focused on building human capacity, strengthening the legal, regulatory, institutional and infrastructure frameworks. They were identified in September 2009 as part of the National Strategy for ICT Development, and are funded through the Public Investment Fund. Some of these projects will receive funds from international donors including the African Development Bank, World Bank and the European Union.

4.3.2 Building Human Capacities

With limited qualitative and quantitative human resources in the managerial and technical field in general, and the ICT field in particular, the government aims to put in place a training program to build the capacity of state personnel in ICT. Related projects include: Training staff and multimedia resource center attendants on the use of ICT and creation of a training center for state personnel. ANTIC has organised annual workshops since 2009 to reinforce ICT-related skills for government officials.

Geographic scope cost and time frame: National, 2 440 000 000 francs CFA from 2010 to end of 2035.

4.3.3 Improving the Legal, Regulatory and Institutional Framework

The development and implementation of a legal, regulatory and institutional framework is likely to facilitate the development of an economic sector through Information and Communication Technologies, to create a competitive environment for the development and the provision of electronic communications services, stimulate innovation, create a framework for reducing costs and diversify the choices of consumers.

The Government recognizes the need to periodically revisit the legal system, regulatory and institutional framework to take account of rapid technological change.

To create a conducive environment for development and delivery of electronic services related to e-government and e-commerce, the following laws were enacted in December 2010:

- Law No. 2010/012 of 21 December 2010 related to cyber security and cyber crime
- Law No. 2010/013 of 21 December 2010 governing electronic communications
- Law No. 2010/021 of 21 December 2010 governing electronic commerce

These laws reinforce Law No. 98/014 of 14 July 1998 governing telecommunications in Cameroon. The overall objective is to create a normative and institutional environment to facilitate and promote the integration of Cameroon in the global information and knowledge society.

Geographic scope, cost and time frame: National, 340 million CFA, 2010 to 2012.

4.3.4 Strengthening the rule of Law and Sovereignty

Information and Communication Technologies will be used as a powerful tool in safeguarding the sovereignty and territorial surveillance to improve population management, the fight against antisocial behavior and behavior that may jeopardize the rule of law. The identification cards are computerized and secured with PKI and biometric technologies, the computerization of judiciary system still ongoing. Projects focused on territorial security include: Data center deployment, putting a Public Key Infrastructure (PKI) in place and a certification authority. The PKI and certification authority are now operational. A feasibility study is being undertaken in relation to the national data center.

Geographic scope, cost and time frame: National, 22 336 259 000 francs CFA, 2010 - 2025

4.3.5 ICT Infrastructure Development

While the national ICT infrastructure was weak, access to ICT services in general and the Internet in particular is based on the deployment of a reliable telecommunications infrastructure.

The Government is committed to develop the electronic communications infrastructure development program. The following projects were undertaken to develop communications infrastructure: National backbone infrastructure (more than 6,000 densify the telecommunications network and Internet development through the implementation of km of Optical Fibre cable has been laid over the national territory with an additional 50km of Fibre Optic forming a mesh in the economic capital, Douala and the capital, Yaounde), extension of government intranet, establishing an Internet Exchange Point (IXP), Wimax telecommunications infrastructure network and equipped multimedia centers.

The Public Key Infrastructure (PKI) Centre is operational since October 2012 hosting two authorities namely: Cameroon's Root Certification Authority and Government Certification Authority. ANTIC has intensified the process of securing the Cameroon's cyberspace with PKI by planning key government applications to be secured in 2015. Key national application secured with this system include: e-procurement (management of public contracts), e-Guce (management of the payment of importation/exportation dues at the sea port) and national social insurance system.

Geographic scope; cost and time frame: National, 98 018 320 000 francs CFA, 2009 - 2012.

4.3.6 Development of Social Sectors through the use of ICT

Based on a perception of low use of ICT in both public and private sectors and within the general population, the Government undertook to ensure ownership of ICT within the health, education, agriculture or rural development sectors. In this era of information society, ICT is an indispensable tool for human development.

Within the framework of the Pan-African online services project supported by the government of India, three pilot projects were undertaken including:

eHealth: The University Teaching Hospital (CHU) in Yaoundé is linked to the hub in Congo Brazzaville for tele-medicine activities

Tele-education: The University of Yaoundé I (National Advanced School of Engineering) has been equipped for online courses in the Central African sub-region.

Tele-diplomacy: The Ministry of External relation has been equipped with communication devices for high-level communication between Heads of States.

Geographic scope, cost and time frame at national level: 4 570 million CFA, 2010 - 2013.

4.3.7 Modernising the Public Service

A major focus of Government policy is to modernize the management of the state with an efficient public administration, decentralization of government, and public participation in decision-making. The capabilities of Information and Communication Technologies to enhance the modernization of public services will ensure the improvement of government's relations with citizens, public and private companies or increase the effectiveness of their internal functioning.

The Government is committed to develop online services (extension of the pan-African online service project with the Indian government, web site development, electronic management of documents and dematerialized procedures, setting up of treasury ATM payments, governmental and national ICT web portals), modernize working tools (extending the government intranet to regions, creating multimedia centers, dematerialization of public contract procedures, electronic archiving of public contract files, computerizing toll gates), scanning the national heritage and develop planning tools for strategic management (integrated fiscal management and financial management & accounting system, accountability of government expenditure, research on socio-economic impact of ICT, developing a strategy and program for e-governance, elaboration of the '.CM' domain name policy, creating a multidimensional statistical database, spatial data infrastructure, computerizing the electoral system, feasibility studies to develop local content e.g. digitizing of national cultural, scientific and touristic heritage). ICT master plans are in the process of elaboration in public administrative units, ministries websites are being developed and a government intranet is ongoing.

In order to have a concrete programme in the modernization of the public sector, ANTIC in partnership with UNU-IIST has elaborated the draft of the electronic governance strategy in Cameroon, the document development is based on consideration of the following perspectives:

- Information and Service Delivery;
- Internal Government Operations;
- Enablers;

➤ Impact on Growth and Development

The Government of Cameroon is currently developing the Implementation of the Strategy and the eGovernment Master Plan. With technical and financial support from the Korean government, the eGovernment Master Plan Development project has been extended to 2017 in order to improve on the quality of the document and a suitable environment to roll-out the plan.

Geographic scope, cost and time frame: National, 30 076 640 000 CFA, 2009 - 2033

4.3.8 Development of an ICT Industrial Sector

Vision 2035 plans to make Cameroon an emerging country. To achieve this, its dominant role as a consumer of technology needs to be changed to that of a producer. In this context, the Government is committed to supporting indigenous development of service industries and ICT products through programs to promote ICT companies and support Research and Development in the area. Partnerships will be developed between the research world and the professional world in Cameroon. Major projects include: organizing a national forum on Internet and ICT governance, feasibility studies to put in place an ICT technopole in Cameroon, creation of a platform for R&D.

Geographic scope, cost and time frame: National, 1 525 000 000 CFA, 2010 – 2013

eServices that are operational:

- SIGIPES (online management of government employees);
- SYSTAC (Driving Licences Management) managed by Ministry of Transport
- SYDONIA (Import & Export Management) managed by the Custom Department, MINFI;
- Electoral System (biometric identification);
- Biometric passports
- eHealth (CHU, Yaoundé), eLearning (Univ. Yaoundé I) and eDiplomacy (MINREX) sponsored by the Indian government.

Some ongoing initiatives

- Primo (e-Procurement) system, which is used for the management of government contracts;
- Tax management, state budget management and public contracts payment management systems;
- Judiciary Management System, which will be used to manage court cases and related issues nationwide;
- National Civil Status Registry System. A national agency was created in 2015 through a presidential decree with the mandate of developing and managing the National Civil Status Registry System.

4.4 National ICT Research Capacity and Priorities for Cooperation

4.4.1 National Priorities

Based on Cameroon's development program (growth and employment) for the period 2010 to 2020, most of the research is focused on the following areas:

- (i) **Infrastructure development:** energy, building construction and public works, transport, water and sanitation, land management
- (ii) **Modernisation of the production mechanism:** rural sector, mining, social economy and handicraft, industry and services, human development, health, education and training, gender, social protection, national solidarity
- (iii) **Regional integration and diversification of trade:** regional integration
- (iv) **Financing the economy:** fiscal policies, banking system, micro finance.

ICT research is also incorporated to develop electronic services including e-health, e-agriculture, e-banking, e-commerce, e-learning, electronic surveyance on transport highways.

National ICT Research Priorities include:

- eInfrastructure – Adaptation of eInfrastructure to the country's environment so as to be cost effective, easy to maintain and sustain. Institutions involved include: University of Yaounde I, University of Douala, University of Ngaoundere and University of Maroua.
- Cyber Security – Put necessary tools in place to secure Cameroon's cyber space. Institutions involved include: University of Yaounde I, University of Douala, University of Ngaoundere and University of Maroua.
- Connected Enterprises – Support SMEs through reduced costs in investment, access to new skills and diversify expertise. Institutions involved include: University of Ngaoundere
- Cloud Computing – Support SMEs through reduced costs in technological investment, increase technology adoption and usage, and improve ICT security. Institutions involved include: University of Ngaoundere and University of Maroua
- Technology Enhanced Learning. Institutions involved include: University of Yaounde I, University of Douala, University of Buea and University of Dschang
- Sustainable Agriculture: Using ICT solutions to address the following issues: soil management, crop planting management, finished product marketing etc. Institutions involved include: University of Yaounde I, University of Dschang, University of Ngaoundere

4.4.2 National Research Capacity

The table below provides an overview of universities with ICT/Engineering Courses:

Institution	Location	Total Students	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Undergraduate Students	Post-Graduate (Masters, PhD)
University of Yaounde I (Faculty of Sciences)	Yaounde	68,000	01	23	1500	320
University of Yaounde I (ENSP)	Yaounde		02	12	150	13
University of Douala (Faculty of Sciences)	Douala	44,000	01	18	480	80
University of Douala (Faculty of Industrial Engineering)	Douala		04	11	350	0
University of Douala (Institute of Technology)	Douala		04	12	280	0
University of Dschang (Faculty of Science)	Dschang	25,000	01	08	1,000	45
University of Dschang (Institution of Technology)	Fotso Victor de Bandjoun		02	12	180	0
University of Ngaoundere (Faculty of Science)	Ngaoundere	17,500	01	15	400	11
University of Ngaoundere (Institute of Technology)	Ngaoundere		02	9	300	0
University of Buea (Faculty of Science)	Buea	16,500	01	6	300	6
University of Buea (Faculty of Engineering)	Buea		02	15	400	0
University of Buea (College of Technology)	Buea		02		400	0
University of Maroua	Maroua	1739	01	15	432	19
Catholic University for Central Africa	Yaounde	2,000	01	5	90	30

The following universities and research centres in Cameroon are undertaking ICT-related initiatives:

➤ **University of Yaounde I**¹⁷⁸

- Depts include: Faculty of Sciences, Department of Computer Science; National Advanced School of Engineering
- Research areas include: Software Engineering; Network Engineering; Electronic and Electrical Engineering

➤ **University of Douala**¹⁷⁹

- Depts include: Faculty of Sciences, Department of Computer Science and Mathematics; Faculty of Industrial Engineering, Department of Computer Engineering; Institute of Technology

➤ **University of Dschang**¹⁸⁰

- Departments include: Faculty of Sciences, Department of Mathematics and Computer Science; Telecom Engineering; Electrical Engineering; Institute of Technology
- Research areas include: Artificial Intelligence; Computer Engineering; Modelling Complex Networks; Software Engineering; GIS; ICT for Education; Modelling of Signal Analysis

➤ **University of Buea**¹⁸¹

- Departments include: Faculty of Sciences, Department of Computer Science; Faculty of Engineering, Department of Computer Engineering; Faculty of Engineering, Department of Electrical Engineering; College of Technology
- Research areas include: Data mining; Information retrieval; Change Management; Information System development

➤ **University of Maroua**

- Departments include: Faculty of Sciences, Department of Computer Science; Higher Institute of Sahel
- Research areas include: Outsourcing Telecommunication; Embedded systems; Software Engineering; Data mining; Networking

➤ **University of Bamenda**

- Departments include: Faculty of Sciences, Department of Computer Science; Faculty of Engineering, Department of Computer Engineering



¹⁷⁸ <http://www.uy1.uninet.cm/>

¹⁷⁹ <http://www.univ-douala.com/>

¹⁸⁰ <http://www.univ-dschang.org/1.8/index.php>

¹⁸¹ <http://ubuea.net/>

➤ **University of Ngaoundere**¹⁸²

- Departments include: Faculty of Sciences, Department of Computer Science; Institute of Technology
- Research areas include: Systems and Software for Distributed Environments

➤ **Catholic University of Central Africa**

- Departments include: Department of Information System;

➤ **Protestant University of Central Africa**

- Departments include: Faculty of Sciences, Department of Computer Science

➤ **Inter-University Research Centre for Information and Communication Technologies, Yaounde**

- To promote the sharing of online resources between Cameroonian universities to support scientific research activities (created by Ministry of Higher Education)

Based on a consultation process, each University has identified their areas of research expertise and track record and has been encouraged to develop an organisational profile. Existing relationships with European research institutions have also been identified. A summary of these findings are provided below:

➤ ***Department of Computer Engineering, National Advanced School of Engineering, University of Yaounde I***

- Research Expertise
 - Simulation of flows in porous media; E-learning concepts and tools; Software testing concepts and tools; Network protocols; Health statistics; Remote system administration based on GSM protocol; Epidemiology; Bio-Informatics; Image Analysis Synthesis; Spatial Information System Techniques; Cryptography and Security
- Existing relationship in place with INRIA, France; IRISA (Rennes-France) & GDAC (Canada)

➤ ***Laboratoire d'Imagerie Spatiale et d'Informatique (LISI) & Department of Mathematics and Informatics, Université de Douala***

- Research Expertise
 - Distance learning environments (Optimal design of interfaces, traffic characterization and modelling, coding and compression of data for optimal transmission, synchronization and authentication of learners)
 - Traffic engineering for integrated services networks (Development of new traffic models that capture the self-similar property of network traffic; performance impact of self-

¹⁸² <http://www.univ-ndere.cm/>

similarity; QoS characterization and provisioning in the presence of self-similar traffic;
Application to network intrusion detection (anomaly detection))

- Geographic Information Systems for environmental management (Remote sensing, processing of remote sensing images)
- Mathematical modelling for epidemiology
- Existing relationships in place with Université Paris-Est (Marne-La-Vallée), France in relation to Geographic Information Systems for environmental management & University of Siegen and the University of Technology of Ilmenau, Germany in relation to Traffic engineering for integrated services networks.

➤ **Department of Mathematics and Computer Science, Université de Dschang**

- Data mining, Distributed systems and services, Scientific calculations, Multi-agent systems, sensors; Parallel Processing; Digital signal processing; Technology-enhanced Learning
- Existing relationships in place with AUF: Agence Universitaire de la Francophonie; Université de Paris 13; Cisco Systems

➤ **Department of Computer Science, University of Buea**

- System Modelling: Organisational Change Management; Agent Modelling and the Dynamics and Transmission of Malaria, Semantic issues in systems); Programming Language Technology (Formal Methods, Transformation Systems, Tools and Semantics);

4.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and additional information collected during the IST-Africa Horizon 2020 Training Workshop in December 2016 the following thematic areas are considered to be important in the context of the ICT-39 Calls:

Thematic Areas	Topics	Partners include
eHealth	Disease prevention, Distance access to medical care, Efficient Epidemic Alerts, Disease Treatment and Management	University of Buea (Dept of Computer Science); University of Ngaoundere (Institute of Technology); University of Yaounde I (Dept of Computer Science), University of Dschang; University of Maroua; University of Doula
eAgriculture	Efficient Climate and Weather Information Management; Crop Management; Efficient Soil Exploitation	University of Maroua (Dept of Computer Science); University of Ngaoundere (Dept of Computer Science & Maths); University of Yaounde I (Dept of Computer Science), University of Dschang; Institute for Agricultural Research for Development (IRAD) Yaounde

Environment	Climate Change Management; Flood and Drought Management; Water & Pollution Management; Forestry & Wildlife Management	University of Maroua (Dept of Computer Science); University of Ngaoundere (Dept of Computer Science & Maths); University of Dschang (Institute of Technology); University of Yaounde I (Dept of Computer Science)
Technology-enhanced Learning	Distance Learning & Student Evaluation; Virtual Classroom; Social Network of Institutions, Scholars & Professions	University of Maroua (Dept of Computer Science); University of Ngaoundere (Dept of Computer Science & Maths); University of Dschang (Institute of Technology); University of Yaounde I (Dept of Computer Science), University of Buea (Dept of Computer Science)

4.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	<p>University of Dschang (Math/CS): Smart Embedded Components and Systems, Large Area Integration and Complex System Engineering</p> <p>University of Maroua (Computer/Telecom): Smart Embedded Components and Systems, and System of Systems;</p> <p>University of Ngaoundere (Math/CS): Complex Systems, Communicating Systems.</p>
Advanced Computing	<p>University of Dschang (Math/CS): Interconnect and Data Localisation Technologies, Cloud Computing, Parallel Computing and Simulation Software</p> <p>University of Ngaoundere (Math/CS): Processor and System Architecture, Cloud Computing and Parallel Computing.</p>
Future Internet	<p>University of Dschang (Math/CS): Networks, Digital signal processing & distributed systems, Software and Services, Wireless Communication, Multimedia and Connected Enterprise, Data Mining, Artificial Intelligence, Software Modelling and Numerical methods</p> <p>University of Ngaoundere (Math/CS): Networks, Software and Services, Wireless Communication, Mesh Networks for Internet coverage, Virtualisation, High performance computing and enterprise services, Ambient devices</p> <p>University of Maroua (CS/Telecommunication): Model Based Software Engineering, Cloud Computing</p> <p>University of Douala (Math/CS): Numerical methods, Software Modelling; Faculty of Industrial Engineering</p>

	(Computer Engineering); Software Modelling University of Beau (CS): Software Modelling
Content Technologies & Information Management	University of Dschang (Math/CS): Technologies for Language, Learning, Machine Learning, Advanced Data mining University of Maroua (Computer/Telecom): Advanced Data mining University of Ngaoundere (Math/CS): Technology-enhanced Learning University of Buea (CS): Technology-enhanced Learning, Digital Content University of Douala (Math/CS): Technology-enhanced learning University of Yaounde I (CS): Technology-enhanced Learning
Robotics	University of Maroua (Computer/Telecom): Service Robotics University of Ngaoundere (Math/CS): Service Robotics, Smart Spaces and Sentient Machines

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	University of Dschang (Math/CS): Wellbeing and Disease, Treating and Managing Disease University of Maroua (Computer/Telecom): Wellbeing and Disease; University of Ngaoundere (Math/CS): Preventing Disease; Methods and Data University of Doula (Math/CS): Mathematical modelling for epidemiology University of Yaounde I (Faculty of Biomedical Science) University of Buea (Faculty of Health Science)
Food Security, Sustainable Agriculture	University of Maroua (Computer/Telecom): Sustainable Agriculture and Forestry; Sustainable and Competitive Agri-food Sector, Sustainable and Competitive Bio-based Industries and Supporting Development of Bio-Economy University of Ngaoundere (Math/CS): Sustainable Agriculture and Forestry. University of Dschang (Faculty of Agronomy) Institute for Agricultural Research for Development (IRAD) Yaounde

Energy	<p>University of Dschang (Math/CS): Reducing energy consumption and carbon footprints by smart and sustainable use, Low-Cost, Alternative Fuels and Mobile Energy Sources, Robust Decision Making and Public Engagement.</p> <p>University of Maroua (Computer/Telecom): Reducing energy consumption and carbon footprints by smart and sustainable use, Low-Cost.</p> <p>University of Yaounde I (Faculty of Science)</p>
Transport	<p>University of Maroua (Computer/Telecom): Resource Efficient Transport that respects the environment; Socio-Economic Research</p>
Climate Action, Resource Efficiency and Raw Materials	<p>University of Ngaoundere (Math/CS): Protection of Environment, Sustainable Management of Natural Resources, Observation and Information Systems</p> <p>University of Yaounde I (Faculty of Science)</p>
Inclusive, Innovative and Reflective Societies	<p>University of Maroua (Computer/Telecom): cultural heritage</p> <p>University of Yaounde I (ENSP)</p>
Secure Societies	<p>University of Maroua (Computer/Telecom): Cryptography, Cyber Security; Risk and Management; Enhance Standardisation and Interoperability of Systems, Including for Emergency Purposes.</p> <p>University of Ngaoundere (Math/CS): Cyber Security, Privacy and Trust</p> <p>University of Yaounde I (ENSP)</p>

Level of Research Maturity

Cameroon has a good research base and experience of collaborative research with involvement from in **23** projects and research funding of **€3.66 million** in FP7. There is a strong aspiration at government level to further strengthening research capacity within the country, and facilitate the continued development of post-graduate programmes. As the number of publication increase the international awareness of specific organisation is also more visible. For example University of Yaoundé I is ranked top 30 in Africa with 876.33 as note for publications and 49.2 as citation score for the period 2009 to 2013 in the December 2015 issue of the Times Higher Education¹⁸³

Up to September 2018, Cameroon has secured 7 Horizon 2020 projects with research funding of over €702,000, across a number of thematic areas:

- LEIT - ICT-39-2015 - **DMC-MALVEC** (RIA - Research and Innovation Action) - Organisation de Coordination pour la Lutte Contre les Endémies en Afrique Centrale

¹⁸³ <http://timeshighereducation.co.uk>

- ERC-2015-CoG - **OurMythicalChildhood** (Universite de Yaounde I)
- H2020-MG-2016-SingleStage-RTD-MOVE - **SaferAfrica** (CSA - Coordination & support action) - Ecole Nationale Supérieure des Travaux Publics
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** - Agence Nationale des Technologies de l'Information et de la Communication
- H2020-SFS-2016-1 - **LEAP-AGRI** (ERA-NET-Cofund) - Ministry of Scientific Research and Innovation
- H2020-SFS-2016-2 - **BREEDCAFS** (RIA) - Institut De Recherche Agricole pour le Developpement
- H2020-MSCA-RISE-2016 - **SLAFNET** (MSCA-RISE) - Universite de Yaounde I

4.5 Innovation Spaces

There are a number of Innovation Spaces active around the country including: *Centre for Entrepreneurship, Research & Innovation* (CERI)¹⁸⁴ hosted by Catholic University Institute of Buea, *ActivSpaces*¹⁸⁵ (Buea and Douala) and *ZixtechHub*¹⁸⁶ (Limbe). Agro-Hub (Buea) is focused on agriculture. These Innovation Spaces are primarily focused on supporting pre-Incubation, Incubation and Acceleration. While CERI focuses on Science, Technology, Engineering and Maths disciplines, ActivSpaces is a tech hub focused on supporting web and mobile programmers, designers, researchers, and entrepreneurs. ZixtechHub provides co-working space and incubation services. A number of innovation spaces are no longer active including *Cameroon Innovation Hub*¹⁸⁷ (Yaounde), which was originally set up in September 2013 as a virtual presence by maooni e.V, a German not-for-profit.

The **CUIB Centre for Entrepreneurship, Research & Innovation (CERI)** was established in June 2011 as the business and research arm of the Catholic University Institute of Buea founded in May 2010. The aim is that over time CERI will evolve into a Research Park, and supports training and development of entrepreneurs, leaders and innovators within the science, technology, engineering and mathematics (STEM) disciplines. CERI is focused on fostering innovation and economic competitiveness through collaboration among national and international stakeholders from the education and research, public and private sectors.

ActivSpaces has established two co-working spaces in Douala and Buea in the West of Cameroon, focused on web and mobile developers, designers, researchers and entrepreneurs. There are a number of business models being applied, including a monthly fee for co-working space offered to freelancers and entrepreneurs, free co-working space for innovative tech start-ups, and revenue

¹⁸⁴ <http://www.cuib-cameroon.org/>

¹⁸⁵ <http://activspaces.com/>

¹⁸⁶ <https://hub.zixtechorganization.org>

¹⁸⁷ www.cihub.net/

share for start-ups accepted in their six month Activation Bootcamp (which started in January 2015). ActivSpaces is a member of the AfriLabs Network. MTN partnered with Microsoft and ActivSpaces to launch a competition from July - October 2015 to identify software developers who can support local content development. The winners received a six month incubation period with ActivSpaces among other items. ActivSpaces has organised a number of events focused on Java and training for start-ups.

Agro-Hub was founded in 2009 based on a recognised gap of marketing and distribution infrastructure for agriculture. During 2015 it focused on inbound marketing for agriculture in Cameroon to provide content to person wishing to buy agricultural products or invest in agriculture in Cameroon. It works with smallscale farmers and buyers to support resilient and sustainable supply chains.

ZIXTECH Hub was set up in 2018 as a division within Zixtech Organisation¹⁸⁸ in Limba. It provides co-working spaces, business support and provides a 6 month incubation program. It became a member of AfriLabs in September 2018.

¹⁸⁸ <https://zixtechorganization.org>

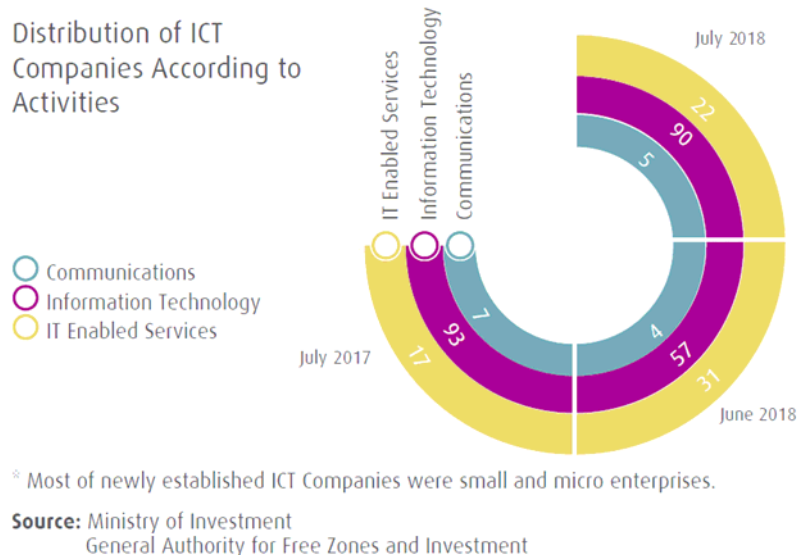
5. EGYPT

5.1 Introduction

Egypt is situated in Northern Africa, bordering the Mediterranean Sea and sharing boundaries with Libya and the Gaza Strip. It has a surface area of 1,001,450 square km, made up of twenty-seven administrative divisions. The population is estimated at 99.41 million inhabitants (July 2018 CIA World FactBook) with literacy rate of 73.8%¹⁸⁹. 62.35% of the total population is between 15 and 64 years of age. Cairo has a population of 20.076 million and Alexandria 5.086 million (2018). The official language is Arabic, with English, French and German widely used within the education systems.



The Government of Egypt recognizes the ICT sector as a critical component of the national economy, not only due to its substantial contribution to employment, exports and diversification of the economy, but for its dynamic and innovative potential, and its broader role in providing enabling technologies, products and services that underpin the development of Egypt as a knowledge-based economy in the global market. The diagram below outlines the distribution and number of newly established ICT companies by activity.



In relation to Communications, according to MCIT and NTRA published statistics, there were 7.67 million fixed line subscribers and 96.36million mobile subscribers (105.16% penetration) as at July 2018. There has been a decrease in the number of mobile subscriptions from 2017 (100.31 million)

¹⁸⁹ CIA World Factbook

due to an increase in the costs of mobile subscriptions. There were 33.15 million mobile Internet subscriptions, 3.44 million USB modem subscribers and 5.99 ADSL subscribers as at July 2018.

In terms of ICT Infrastructure, FLAG, SMW4 and SMW3 are the three marine cables connecting Egypt to the rest of the world. The existing backbone is a result of the PPP between the Egyptian Government and the private sector. Telecom Egypt is the largest provider of fixed line services. It also provides retail telecommunications services (voice, Internet and data) and is the sole provider of wholesale telecommunications services. It provides broadband capacity leasing to ISPs and national and international interconnection services. Egypt has four mobile providers: We (launched by Telecom Egypt in September 2017), Orange, Vodafone, and Etisalat Misr. National Telecommunication Regulatory Authority (NTRA) officially activated the high-speed 4G service to the four mobile service providers in September 2017.

CAIX¹⁹⁰, the National IXP, was established in 2002, funded by the Government of Egypt through MCIT and managed by National Telecommunication Regulatory Authority (NTRA). CAIX's mission is to connect all Class A and B ISPs in Egypt to exchange the local traffic inside Egypt and save their international bandwidth. All Class A ISPs are members in CAIX. There are four ISPs (TEDATA, Vodafone, OrangeDSL, Etisalat) connected via giga interface and three ISPs (Noor, MenaNet, YALLA) via Fast Ethernet.

The "eMisr" National Broadband plan is committed to increasing broadband Internet penetration in Egypt and endorsing the development of a digital society. The plan was launched in 2011 and was revised in 2014. It proposes different strategic directives to meet Egypt's broadband service needs. It aims to position Egypt as a leader in digital communications, create more job opportunities and promote the use of ICTs across government sectors, thus improving quality of life for citizens and reducing the digital divide between urban and rural communities.

The Government established a root certificate authority (PKI Trust center) at the Information Technology Industry Development Agency (ITIDA) and Governmental Certificate Authority at the Ministry of Finance. 3 private sector owned CAs were licensed, of which two are operational. Plans are ongoing to integrate the PKI digital certificates within the (contactless smart) national ID card. Several PKI based pilot projects and services have been launched in the governmental sector, banks and stock market.

Egypt is a member of several international organizations such as the International Telecommunication Union (ITU), the International Mobile Satellite Association (IMSO), and the International Telecommunication Satellite Organization (ITSO) and IGF. It is also a partner in GSM Association. It is a member in the Arab Regulators Network (AREGNET), the Arab ministerial conference affiliated to the League of Arab States, the Euro-Mediterranean Regulators Group

¹⁹⁰ www.caix.net.eg

(EMERG) and (ARICEA) Association of Regulators of Information and Communication for Eastern and Southern Africa.

There are 29 public universities, 43 private universities and more than 400 private institutions of higher education. Of these 66 have Departments focused on ICT/Engineering.

SDS (Sustainable Development Strategy): Egypt's Vision 2030 pays specific attention to enhancing scientific research, upgrading the technological capabilities, encouraging innovation and increasing R&D spending as they represent the core for the sustainable development of the country. The main pillars of Vision 2030 are outlined in this diagram:



5.2 ICT Background

There is a strong emphasis on applied ICT research and development as Egypt diversifies from natural resources to a focus on creativity and innovation. The Ministry of Communications & Information Technology (MCIT) launched an R&D initiative with a set of strategic objectives to emphasise the importance of, and promote, R&D in the ICT industry and the applications of ICT R&D in other sectors. This initiative launched Research and Development Centres of Excellence to support collaboration between academic and industrial institutions at a national and international level. The Technology Innovation and Entrepreneurship Centre¹⁹¹ (TIEC) aims to support innovation and entrepreneurship in ICT and thus drive the economy.

In the formulation of Egypt's ICT Policy (2013 – 2017), the primary considerations were the political and economic changes in Egypt since the 25th January 2011 revolution, the development of the communications sector both regionally and internationally, supporting the country's transition to democracy and Egypt's national development priorities. The new strategy is focused on achieving sustainable socio-economic development through Digital Identity using ICT solutions, ICT Industry Development, creating job opportunities and attracting Foreign Direct Investment. It focuses on integrating ICTs across all sectors to serve national development priorities, including preserving natural resources and the environment. Key ICT sectors to be supported include Digital Identity, Egypt Digital Hub, Basic Infrastructure (Broadband, Cloud Computing, Submarine Cables), Cyber Security & eSignature, Information Infrastructure & Digital Content, Electronics Design & Manufacturing, Legislative and Policies Framework.

¹⁹¹ <http://www.tiec.gov.eg/en-us/Pages/default.aspx>

The National ICT Policy (2013 – 2017) is an important part of the National Development Plan building on Egypt's unique geographical location and optimum utilisation of Submarine Cables to become a Global Internet Hub. The eGovernment Strategy has been in place with MCIT's policies since 2003 and its implementation follows three guiding policies: Citizen Centric Service Delivery; Community Participation and Efficient Allocation of Government Resources. The policies are sub-divided by the primary sector that will implement them:

- Government - focused on Cloud Computing, Digital Identity Management, Open Source Software, Access to information, Green ICT and Arabic Digital Content
- Civil Society - focused on Mobile Phone Applications, Arabic Digital Content, Empowering people with disabilities
- Private sector - focused on eCommerce

In February 2012, the five-year ICDL-Egypt Scholarship Program concluded, having provided ICDL certification to 836,801 Egyptians, 58% of whom were female. The MCIT and the ECDL Foundation launched a new phase of the ICDL-Egypt Scholarship Program, running from 2012 to 2013, with a further 5,530 candidates certified in November 2013.

In September 2011, MCIT launched the IT Houses initiative to offer training courses, eGovernment service and SMS services. As at August 2014, there were 126 IT Houses established across the country. There were 2,163 IT Clubs of which 1,955 are connected to the Internet.

MCIT supports the development of a knowledge and digital economy by providing affordable access to knowledge and development of a competitive, innovative national ICT industry.

The “National Technology Leaders” was launched in 2015 as a country wide presidential initiative. This initiative aims to raise the competency of youth in all technology fields. It utilizes e-learning and interactive teaching methodologies to build capacity of students on a large scale. Special interest is also given to people with disabilities. In October 2017, it was reported that there are more than 5,000 graduates from this initiative who have received high quality training from international universities and research centers in many advanced technology areas.

ICT 2030 strategy supports the development of the communications sector both regionally and internationally by designing new initiatives such as the electronics design and manufacturing and capacity building to maximize ICT contributions to the economic growth of the country.

In May 2016 the MCIT established the Silicon Waha¹⁹², a joint stock company that aims at creating a series of specialized business and technology parks across 2nd tier cities in Egyptian governorates. The company stakeholders include the Ministry of Communications & Information Technology (MCIT), Information Technology Industry Development Agency (ITIDA), and the New Urban Communities Authority (NUCA) of Egypt. The vision is “to reach out to Egypt's talented youth

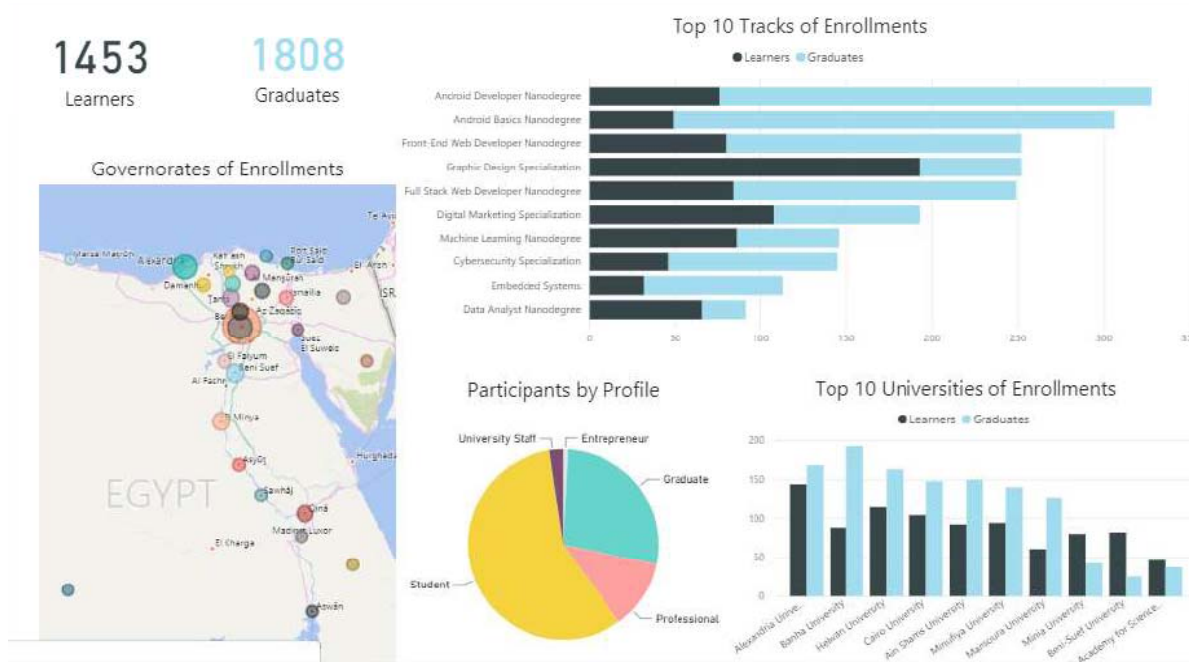
¹⁹² <http://siliconwaha.net/>

everywhere and provide the ecosystem that enables them to create value through the transformation of innovation and technological advancements for Egypt's welfare and to lead the way to a better life style in our communities". It aims to establish 6 technology parks across Egypt (Borg Al Arab, New Assiut, 10 Ramadan, Sadat City, Beni Suef, Aswan), with the first three expected to open during 2017.

MCIT leverages best practices and international standards to implement Egypt's strategy for the transition to a digital society. Capacity building programs for youth are provided by MCIT through the Information Technology Institute (ITI) and the National Telecommunications Institute (NTI). To date 6,000 trainees have participated. Over time MCIT plans to add more disciplines to support youth to learn about the latest ICT technologies.

The eCommerce strategy was launched in December 2017. The Cybercrime law has been issued and its executive regulations will be issued soon. Cabinet has approved the Data Protection Law. The eCommerce Law is currently being prepared.

The government of Egypt has launched the presidential initiative called Next Technology Leaders (NTL). It aims to build the capacity of young calibers on the latest ICT and electronics technologies. MCIT through its technical arm the Technology Innovation and Entrepreneurship Center (TIEC) of the Information Technology Industry Development Agency (ITIDA) is responsible for its implementation. It will encourage students, recent graduates, and young IT professionals to take advantage of the vast knowledge and recent technologies available on globally leading MOOC platforms. The ecosystem is inclusive of a nationwide network of study group mentors that coaches learners and stimulate the learning process. The following figure shows the current state of the implementation of the initiative as reported on the NTL website



ICT represents a core component in all country initiatives and large-scale projects. The new capital city of Egypt is designed to be smart and it heavily uses ICT advanced technologies from the infrastructure level to citizen applications and services. This smart city aims to attract large numbers of technological personnel from innovators, technicians and entrepreneurs. It will include centers for research, science, innovation and entrepreneurship, as well as some of the specialized universities, centers and institutes for technological training.

5.3 Current ICT Initiatives and projects

ICT Initiatives are focused on eLearning, eHealth, eGovernment, eContent, Community Integration and ICT for people with disabilities; Broadband Access Network and Internet of Things.

5.3.1 ICT for Learning

MCIT has invested in projects and programs to support sustainable human development including:

- Education Development via Information and Communication Technology (ICT)
- Illiteracy Eradication Initiative
- E-Learning Competence Center (ELCC)
- ICT for Micro, Small and Medium Enterprises
- Digital Libraries

The Egypt Education Initiative (EEI) was launched as a public-private partnership between the Government of Egypt and the World Economic Forum's ICT community as a progressive model for reforming Egypt's education system. The EEI seeks to add value to the national education process in new and innovative ways, directly improving the quality of education.

5.3.2 ICT for Health

The Government of Egypt and its Ministry of Health have established several e-Health programs to bring better diagnostic and health services to a wider segment of the Egyptian society. MCIT has facilitated the integration of ICT in health services and the provision of medical education to remote or underserved areas of Egypt. The e-health initiative aims to provide equal opportunities to health services anywhere in Egypt, and expand medical insurance to all citizens. The main components/projects include:

- National Network for Citizen Health Treatment at State's Expense
- Pilot Project for Hospital Automation
- National Cancer Registry Program of Egypt
- PAN-African E-Network
- Educational Hospitals and Institutes Development
- Bab El sharia University Hospital Automation and Development
- AL-Azhar Specialized Hospital Automation and Development
- Critical Care Medicine Department Development

- Alexandria University Hospitals Development
- Health Insurance Organization Outpatient Clinics Development
- Cardiovascular Unit Automation at Ain Shams Hospital
- National Diabetes and Endocrinology Institute Operation Automation
- Health Insurance Organization Laboratories Information Network
- Egyptian Ambulance Organization Development
- National Network for Treatment at the Expense of the Country
- Automating the System of Intensive Care Units and Ambulances in Hospitals of the Ministry of Health
- Databases for Nurseries and Blood Banks
- Social Citizen Awareness of Non-Communicable Diseases such as Diabetes, Hypertension, Hepatitis, Tumors, etc.

5.3.3 ICT for Government

MCIT was instrumental in introducing eGovernment in Egypt from 2003 and extending ICT into public services. MCIT supports other Ministries in facilitating e-Government programs and services as part of the Egyptian Information Society Initiative (EISI). It aimed to modernize the citizen interaction with government by introducing ICTs to the internal operations of government departments and to their interface with the public.

The main components/ projects include:

- Digital Transformation
- Tax Reform
- Digital Bill
- Farmer Card
- Database Integration
- Central Auditing Organization
- Central Agency for Organization and Administration
- South-South Cooperation Portal
- Central Agency for Public Mobilization and Statistics
- Automation of Central Poultry Production Quality Control Laboratory
- Development of Environmental Monitoring Units in Cairo
- E-Indications Database Building for Measuring Information Society
- Gomhoreya Newspaper Hotline 139 Development
- Commerce Chambers Automation
- Automation in Fisheries
- Real Estate Finance Fund
- Increasing Productivity and Efficiency of the Government Bodies
- e-Payment

- National Integrated Databases for Citizens
- 'Tahya Misr Fund' Work System
- General Organization for International Exhibitions and Fairs (GOIEF)
- Infrastructure Development of the City of Luxor
- National Organization for Potable Water and Sanitary Drainage
- Upgrade of the Central Agency for Organization and Administration (CAOA)
- National Council for Childhood and Motherhood
- e-Government Applications
- Enterprise Resource Planning (ERP) Systems
- Ministry of Finance
- Central Agency for Public Mobilization and Statistics (CAPMAS)
- MFTI Economic Databases and Decision Support Services

5.3.4 E-Content

The digital content industry encompasses the creation, design, management and distribution of digital products and services and the technologies that underpin these activities. Egypt places a high priority on developing and distributing Arabic e-Content that forms the basis of intellectual and cultural inspiration for future generations. Accordingly, MCIT has supported the establishment of an e-content industry in Egypt through its Arabic e-content initiative. It aims to enhance the competitiveness of the Egyptian e-content industry by supporting the production, use and distribution of Arabic digital content on global networks.

The main projects include:

- Ministry of Tourism Cabinet Office Library Automation
- Automating, Retrieving and Archiving Parliament Minutes
- Dar Al-Tahrir Printing and Publishing
- Siwa Heritage Documentation
- Mobile Applications for Tourism Promotion
- Improving Egypt Tourism Authority Websites on Search Engines
- Microsite for Tourism Campaigns Activation
- State Information Service Portal Infrastructure
- Productivity Enhancement Initiative Applications
- Live Streaming Channel
- Industrial Development Authority e-Portal
- Egypt Memory Online Shop
- Eternal Egypt
- The Architectural and Urban Heritage
- Beit Hathor
- Islamic Cairo Heritage

- Islamic Heritage Cities Exchange Platform
- Islamic Inscriptions
- Muslim Scientists Project
- Photographic Memory of Egypt Program
- El-Orman Digital Map
- Documentation of Al-AZHAR Al-Sharif Memory
- Botanical Gardens In Egypt Documentation
- Memory of the Arab World
- EGHeritage
- Archaeological Map of Egypt
- Egyptian Knowledge Bank (<http://www.ekb.eg/>)

5.3.5 Access for All

MCIT seeks to guarantee universal, easy, affordable and rapid access for all Egyptian citizens to ICT, and stimulating awareness of the potential uses and benefits of ICT. In this respect, MCIT has implemented a number of programs with the chief aim of providing benefits to users, promoting computer literacy, and encouraging increased use of ICT by the public including:

- IT Clubs
- Mobile Internet Unit
- Egyptian Olympiad in Informatics
- Egypt PC 2010 – Nation Online

5.3.6 Green ICT

Greening ICT, or applying user-friendly policies, has become a dire need. Environment protection is an important issue for human safety, for sustaining social and economic development, and for preserving natural gifts for next generations. ICT tools constitute very important potential for protecting the environment, creating solutions for decreasing toxic emissions by other sectors.

5.3.7 Legislative Services

MCIT collaborates with Ministry of Justice to enhance the Government's performance, facilitate work in ministries and affiliates, promote and increase the efficiency of the various legislative services provided. This is aligned with developing IT government infrastructure and digital services, which aim to move from paper based systems to e-transactions, thus securing documents, improving work conditions for employees and enhancing efficiency. It focuses on developing how citizens interact with Government bodies by applying ICT techniques in internal processes. The main components/projects of this initiative include

- Automation of Agricultural Land Registration
- Personal Status Document Archiving – Public Prosecution

- Banned from Acting Network
- Developing Documentation Offices and Illicit Gains Authority

5.3.8 Internet Safety

MCIT established a National Committee for Child Online Safety to synchronize and coordinate efforts in relation to Internet security. The main components/projects include:

- National Committee for Child Online Safety
- Legislative Framework
- Online Arabic Content
- Work Mechanism
- Technology Solutions
- Law Enforcement
- Awareness Raising and Capacity Building
- Education
- Availing Arabic Content
- Regional and International Cooperation.

5.3.9 ICT for Community Integration

MCIT's efforts to increase community integration using ICTs are aimed at: empowering rural and marginalized communities through development projects and raising awareness of benefits of ICTs; promoting development in rural and marginalized areas through application of technology solutions to establish an integrated sustainable development model; empowering women through illiteracy eradication programs; and improving services in education, healthcare and supporting SMEs. The main projects include:

- ICT for Illiteracy Eradication
- Kenana Online Community Development Portal.
- Telecenter E-Learning Academy
- Community Development Portals
- Telecentre Network
- Youth Social Entrepreneurship Program
- ICT for M/SMEs Development Program
- Mobile IT Clubs
- ICT for Illiteracy Education
- Youth Employment Generation
- Integrated ICT for Development in SIWA OASIS
- Managing Agriculture Knowledge
- Mobile IT Unit and Universities Ideas Bank
- Integrated ICT Solutions and Development – Nuba Project.

5.3.10 ICTs for People with Disabilities

In March 2012, MCIT launched the ICTs for People with Disabilities initiative, which aimed to improve the quality of life for people with disabilities by using ICTs to facilitate access to information and knowledge, boost interaction with the community and increase opportunities for employment. The initiative involves the participation of people with disabilities and organizations representing their interests, and focuses on integrating people with disabilities in the Egyptian society and empowering them through ICTs. It aimed to remove barriers and facilitate opportunities for people with disabilities – using ICTs to develop their abilities and potential – and enabling them to enjoy their rights, fulfil their responsibilities, and participate fully in developing their communities and society. The main components/projects included:

- Jobs and Skills for Persons with Disabilities with Focus on ICT-Based Solutions
- Supporting Hearing and Visually Impaired Students
- Tamkeen Portal
- Technical Support for Inclusive Community Centers
- International Computer Driving License for PwDs
- Training for Better Employment Opportunities
- Launch of an Accessible Web Portal
- Development of Inclusive and Special Needs Schools
- Development of Centers for Disability Services at Egyptian Universities
- Development of a Unified Egyptian Sign Language Dictionary
- Employability Enhancement Program
- Tamkeen Competition
- Support of the National Council on Disability Affairs
- e-Learning for Schoolchildren with Hearing and Sight Impairments.

MCIT adopted specific policies to empower people with disability through ICT, to increase access and to involve people with disability in determining government policies and strategies.

5.3.11 Cross cutting areas

MCIT has adopted policies to support a conducive environment, standards and applications for

- Arabic Digital content development
- Cloud computing - to promote use of cloud computing technologies and relevant applications
- Digital Identity Management - to promote privacy and personal security in cyberspace
- eCommerce - to promote uptake and confidence
- Mobile applications - increase access to applications and provide universal access to services
- Open source software - to increase the use of open source software by government and in development applications
- Intelligent Transportation Systems

5.4 National ICT Research Capacity and Priorities for Cooperation

5.4.1 National Priorities

National ICT Research Priorities include Technology Innovation and Entrepreneurship; Biomedical Informatics Research; Digital Identity; Basic Infrastructure (Broadband, Cloud Computing, Submarine Cables); Cyber Security & eSignature; Information Infrastructure & Digital Content; Electronics Design & Manufacturing.

- Smart cities and emerging telecoms technologies including 4G/5G and Optical Access Networks (FTTH, FTTC) technologies, and SDN. In addition, all aspects related to the design, implementation and management of smart cities are also of great focus. Main responsible entities in Egypt include ITIDA and NTRA (both entities operate under the umbrella of the MCIT).
- Internet of Things and Blockchain: Egypt has established the IoT-Egypt Forum in 2014 (iot-egypt.com) to form the national focal point for the IoT community in Egypt. The structure of the forum consists of a steering committee, members, and working groups. Steering Committee currently has 11 members that represent SMEs, government, multinational, and NGOs. Three main Working Groups were formed from the community with the aim of studying a focus area of interest to the IoT community and identify potential needs and opportunities. Membership is open for public currently to participate in all IoT activities in Egypt.
- Software Engineering for Space Sciences: Egypt is currently planning to tap into the space science field. The government plans to establish the national Egyptian space science center. A key focus in this area is currently on the software and applications needed for space sciences. A national committee has been formed in 2016 and studied the potential needs and research areas needed in this direction.
- Cyber-attacks and ICT for Homeland Security: With the emergence of ICT technologies and its application in almost every aspect in life, a key current focus in Egypt is to establish and study advanced cyber-security technologies to protect and enable the current and emerging ICT infrastructure.
- Design and manufacture of electronics: Egypt is currently planning to open factories for the design and manufacturing of electronics at national level so that it will contribute to improving the economy through covering a high percentage of the country demand from electronics and also through exporting.
- E-Commerce: Egypt plans to leverage its growing ICT infrastructure to support mature realization for e-commerce technologies and applications. In particular, several financial initiatives have been implemented over the last few months that can support the implementation of e-commerce in various verticals. The main financial initiatives include the large-scale

implementation of the financial inclusion initiatives that has led to the key decision of reducing the use of cash for payment for all government services by Jan 2019. Moreover, MCIT has published its e-commerce strategy that takes into consideration not only the recent technological advances, but also the major financial reforms that took place recently in Egypt. The full e-commerce strategy was released in early 2018 and can be accessed via the MCIT official website.

In addition to the above, the following is a list of some key national research priorities in ICT-enabled Applications:

- Agriculture and irrigation (e.g. Automation of agricultural tenure)
- Environment sector (sanitation, water treatment, desalination, waste treatment)
- Sustainable Food Production:
- Climatic and extra climatic factors affecting livestock, aqua fisheries and sustainable crop production.
- Innovative solutions for combatting emerging infectious livestock diseases.
- Waste management and biofuel production.
- Advanced trends to improve livestock productivity
- Sustainable water management (Sanitation technology, Advances in desalination technology)
- Affordable & Inclusive Healthcare (Cancer, Translational medicine, Chronic diseases, Geriatric medicine)
- Renewable Energy (New trends in renewable energy, Advances in energy storage systems)

5.4.2 National Research Capacity

The table below provides an overview of some of the universities with ICT/Engineering Courses:

Institution	Location	Total Students	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Undergraduate Students	Post-Graduate (Masters, PhD)
Cairo University	Giza	271,000	Faculty of Computers and Information – Dept of Information Technology, Dept of Computer Science Faculty of Engineering – Dept of Electrical and Communication	Prof: 8 Lecturers: 13 Technical Support Staff: 2	250,000	153 Masters awarded up to 2010 9,000 Masters and 1,200 PhD candidates 40 PostGraduate Students in ICT/Engineering
Helwan University	Cairo	78,309	Faculty of Computers and Information Systems	Prof: 3 Lecturers: 6 Technical Support Staff: 6 per college	4,000 169 ICT / Engineering	2,500 30 ICT/Engineering PostGraduate students
Nile University	Giza		School of Communications & Information Technology, School of	12 Full time, 8 part-time, 10 visitors	96	575 Masters 27 Applied PhD Candidates

			Engineering and Applied Sciences			
Zewail City of Science and Technology	Giza	450	Learning Technologies Dept	Prof: 6 Lecturers: 21 Technical Support Staff: 10	430	14 Masters 6 Applied PhD Candidates
American University of Cairo	Cairo	6,720	Dept of Computer Science and Engineering	Prof: 13 Lecturers: 21 Technical Support Staff: 10	207 ICT/Engineering	83 PostGraduate ICT/Engineering
Heliopolis University	Cairo	140	Faculty of Engineering	Prof: 3 Lecturers: 6 Technical Support Staff: 3	30 ICT/Engineering	
National Telecommunication Institute	Cairo		Computer Dept., Networks Dept., Transmission Dept., Switching Dept. and Electronics Dept.	19		15 PostGraduate Students
Ain Shams University	Cairo		Computer Science Dept.	211	1,531	9
Alexandria University	Alexandria		Faculty of Engineering – Computer and Systems Engineering Dept	79	306	
Mansoura University	Dakahlia		Computers and Information Faculty	42		
Monofya University	Monofya		Faculty of Engineering – Electronics Dept.			
Assiut University	Assuit		Faculty of Computers and Information	39	858	394
Beni Suef University	Beni Suef		Faculty of computers and information (teaching and research)	Prof: 3 Lecturers: 10 Technical Support Staff: 17	405 ICT/Engineering	1051 Masters and 604 PhD students
Arab Academy for Science, Technology and Maritime Transport	Cairo		College of Computing and Information Technology	Prof: 10 Lecturers: 5 Technical Support Staff: 3	300 ICT/Engineering	300 Masters and 700 PhD students

Based on an initial consultation, the following Universities and research centres in Egypt undertaking ICT-related initiatives have identified their areas of research expertise and track record and have been encouraged to develop an organisational profile. Summary findings are provided below:

➤ **Cairo University**¹⁹³

- Depts include: Faculty of Computers and Information – Dept of Information Technology and Dept of Computer Science; Faculty of Engineering – Dept of Electrical and Communication
- Research Groups include: Mobile Computing, Semantic Computing, Optical Networking, Data Mining, Big Data, Optimization and Operation Research, High-Performance Computing
- Semantic Computing and Web. Skills include: Implementation and deployment of semantic web technologies including RDF, RDFs, SPARQL and Zamenta. Industrial pilot within RECOCAPE FP7 project
- Research areas include: Wireless Communication & Networks, Electronic Design, Embedded Systems (Electronics and Communications Dept); Future Internet, Information Management including Big Data, Content Management and Content Technologies (Faculty of Computer Information); Bioinformatics, Persuasive Computing, Networks (Systems and Biomedical Dept)

➤ **Helwan University**¹⁹⁴

- Departments include: Faculty of Computers and Information Systems
- Research Groups include: Human Computer Interaction, Computational Linguistics, Cloud Computing, Data Mining, High Performance Computing, Soft Computing, Medical and Bio-Informatics, Business Intelligence, Image Processing, Medical Engineering, Security, Data Management, Conceptual Mapping, Knowledge Engineering, Computer Arabization and Islamic applications, Information Security, Multi-level Optimisation, Speech Processing and Machine Learning, Intelligent Decision Support Systems, Mobile Computing

➤ **Nile University**

- Departments include: School of Communications & Information Technology, School of Engineering and Applied Sciences, Wireless Centre
- Research Groups include: Informatics, Image processing, Bioinformatics, Wireless technologies, Information security, Nano-electronics, Software engineering, Mechatronics
- Research areas include: Wireless Communications, Wireless Networks, Applications for Health, Social Networks

➤ **Zewail City of Science and Technology**¹⁹⁵

- Departments include: E-Learning department
- Research Groups include: Technologies for Learning; Big Data Technologies' Advanced Data Mining, Machine Learning, Statistical Analysis and Visual Computing

¹⁹³ <http://cu.edu.eg/Home>

¹⁹⁴ <http://www.helwan.edu.eg/english/>

¹⁹⁵ <http://www.zewailcity.edu.eg/>

- Research areas include also: Wireless Communications and Smart Integrated Systems
- **American University of Cairo**¹⁹⁶
 - Departments include: Department of Computer Science and Engineering; Department of Electronics Engineering; Department of Mathematics and Actuarial Science; Department of Mechanical Engineering; Department of Petroleum and Energy Engineering; Yousef Jameel Science and Technology Research Center
 - Research areas include: Text Mining, Image Processing, Mobile Computing; Computer interaction, EE multicore systems, Wireless sensor networks, pervasive and ubiquitous systems; Embedded multicore systems, VLSI implementation aspects of CPU micro architecture; Wireless sensor networks platforms and applications computer architecture / micro architecture; Arabic handwritten & Arabic voice recognition; Renewable Energy; Energy Efficiency; Entrepreneurship
- **British University in Egypt (BUE)**¹⁹⁷
 - Departments include: Faculty of Informatics and Computer Science (ICS)
 - Research areas include: Cloud Computing, Cyber Security, Mobile-based Health Applications (self-service)
- **Heliopolis University**¹⁹⁸
 - Departments include: Faculty of Engineering - Department of Mechatronics, Department of Energy and Department of Water
 - Research Groups include: Robotics, Community Services, Waste treatment and waste management
 - Heliopolis University has signed MOUs with: Universitat Hohenheim (Germany), Weingarten University of Education, University of DUNDEE (UK), University of Graz (Austria), Graz University of Technology (TUG) (Austria), University of Nicosia, Steinbeis University Berlin, Munich University of Applied Science, Liverpool John Moores University, University of Portsmouth, University of applied sciences Mittweida, Mechatronics Association in Germany, Alanus University, BOKU University of Natural Resources, Leipzig University, Phillips University Marburg, Jepson School of Leadership Studies, University of Koeln, Bochum University, University of Osnabruck
 - Involved in the following internationally funded projects: **Tempus**: DIMPTOT: Development of an industry linked Mechatronics Program with Training of Trainers; RUCAS: Reorient University Curricula to Address Sustainability; Development of Joint International Master Degree and Lifelong Learning Framework in Mechatronics (JIM2L). **FP7**: MED SPRING:

¹⁹⁶ www.aucegypt.edu

¹⁹⁷ <http://www.bue.edu.eg/>

¹⁹⁸ www.hu.edu.eg

Mediterranean Science, Policy, Research & INnovation Gateway; **ADA**: Establishment of a market for solar water heaters in Egypt

➤ **National Telecommunications Institute**¹⁹⁹

- Departments include: Computer Dept., Networks Dept., Transmission Dept., Switching Dept. and Electronics Dept.
- Research areas include: Cloud Computing, Wireless Communications, Optical Networks, Smart Transport Systems

➤ **Information Technology Institute**²⁰⁰

- Departments include: Biomedical Informatics center of Excellence (BMICoE), eLearning Centre of Excellence (ELICA), Java Education and Technology Services (JETS) Centre of Excellence, System Development and Gaming Centre of Excellence (SDGCoE), Mechatronics Department, Open Source Department, Geographical Information System (GIS) Department

➤ **Software Engineering Competence Center (SECC)**²⁰¹

- Departments include: R&D, Consultation and Training Department
- Research areas include: Service Oriented Architecture, Cloud Computing, Semantic Web, Model Driven Engineering, Ubiquitous Computing, Mobile Application Development, Embedded Software Development
- Involved in the following internationally funded projects: RECOCAPE: SECC of Egypt, Tecalia of Spain, VTT of Finland, and UNIBO of Italy formed an integrated consortium and proposed the RECOCAPE project to leverage Egypt's competencies in four state-of-the-art technologies; SOA/ESB, Semantic Web, MDD, Ubiquitous Computing. The "RECOCAPE project started November 2011 for 36 months and SECC was the coordinator of the project
- The Software Engineering Competence Center (SECC), affiliated to ITIDA, is an Egyptian leading organization in enhancing the quality, efficiency and level of innovation of ICT companies. Its aim is to promote the companies' global competitiveness by improving the process and content of their product or service production. It supports the development of the software industry through the provision of training, assessment, consultation and certification. Over the past few years, SECC has developed its training services to provide a growing number of beneficiaries with knowledge of technologies, frameworks, models and best practices for software engineering and IT service management. SECC developed an effective engagement model enabling it to tailor its service offerings to the needs of different markets and target groups in support of this diversification.

¹⁹⁹ <http://www.nti.sci.eg/>

²⁰⁰ <http://www.iti.gov.eg>

²⁰¹ <http://www.secc.org.eg/>

- **Ain Shams University**²⁰²
 - Departments include Engineering
 - Research areas include: Future Networks, Embedded Systems, Language Technologies, Micro and nano-electronics, micro systems, Photonics, Microwave
- **Azhar University**²⁰³
 - Departments include: Computer Engineering
 - Research areas include: Natural Language Processing, Content Technologies and Analysis
- **Arab Academy for Science, Technology & Maritime Transport**
 - Departments include Electronics and Communications, College of Computing and Information Technology
 - Research areas include: Design, Communication Antennas, Encryption, Solar Energy, Fabrication, High Performance Computing including Grid and Cloud Computing (Electronics and Communications); Big Data Technologies, Advanced data mining, Informatics, Computers and Society (eLearning, eVoting, eBilling), Network protocols and programming (College of Computing and Information Technology)
- **Beni Suef University**²⁰⁴
 - Departments include: Faculty of computers and information
 - Research areas include: Cloud Computing, Technologies for IoT, Health data collection
- **Alexandria University**²⁰⁵
 - Research areas include: Future Networks, Embedded Systems
- **Mansoura University**²⁰⁶
 - Research areas include: Future Networks, Embedded Systems
- **Assiut University**²⁰⁷
 - Research areas include: Future Networks, Robotics, Patterns and Image Processing
- **Suez Canal University**²⁰⁸
 - Research areas include: Biometrics, RFID Technologies, Cryptography)
- **Aswan University**²⁰⁹

²⁰² <http://www.shams.edu.eg/>

²⁰³ <http://www.azhar.edu.eg/En/index.htm>

²⁰⁴ <http://www.bue.edu.eg/>

²⁰⁵ <http://www.alexu.edu.eg/index.php/en/>

²⁰⁶ <http://www.mans.edu.eg/en>

²⁰⁷ <http://www.aun.edu.eg/>

²⁰⁸ <http://scuegypt.edu.eg/en/>

²⁰⁹ <http://www.aswu.edu.eg/>

- Research areas include: Millimeter Waves, Cognitive Radio
- **Benha University**²¹⁰
 - Research areas include: VLSI, Signal Processing
- **South Valley University**²¹¹
 - Research areas include: Artificial Intelligence, Signal Processing
- **Menofiya University**²¹²
 - Research areas include: Cryptography, Optical communication, Femtocell, Heterogeneous networks, Wireless sensor networks

5.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders the following thematic areas are considered important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners include
eHealth	Health diagnosis and Telemedicine; Prevention and Treatment of HepC, Malaria etc; Self-management of healthcare; Integrated care; Rural access to ehealth services for young medical professionals	Cairo University (Department of Systems and Biomedical Engineering); Beni Suef University (Faculty of Computers and Information); Nile University (School of Communications & Information Technology, School of Engineering & Applied Sciences); American University of Cairo ; British University of Cairo (Faculty of Informatics and Computer Science)
eAgriculture	Geospatial data references for agricultural products; Access to pricing information	ITQAN for Smart Solutions ; Nile University (Center for Informatics Science) Heliopolis University (Heliopolis Academy Lab for Biodynamic Agriculture and medicinal plants); National Research Centre
Technology-enhanced Learning	Personalised Learning Systems, Smart Education	Beni Suef University (Faculty of Computers and Information); Zewail City of Science and Technology ; Software Engineering Competence Centre (SECC)
eGovernment	Big Data	Software Engineering Competence Centre (SECC) ; Zewail City of Science and Technology ; Sadeem
Energy	Renewable Energy, Smart Grids, Energy Efficiency, Smart Cities	Nile University (Nano Electronics Integrated Systems Center, Center for Nanotechnology); American University of

²¹⁰ <http://bu.edu.eg/en/>

²¹¹ <http://www.svu.edu.eg/>

²¹² <http://www.menofia.edu.eg/Home/en>

5.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	<p>Cairo University (Depts of Information Technology, Computer Science, Electrical and Communication): Smart integrated systems, Technologies for IoT. Skills include: Smart-M3 architecture and implementation. Ontology development. Service Oriented Architectures (SOA).</p> <p>Nile University (Nano Electronics Integrated Systems Center and Wireless Intelligent Networks Center): Embedded Systems, High Performance Integrated circuits, Computer Aided Design of Integrated Circuits, RF ID, Micro-Electro-Mechanical devices, Many core chip design</p> <p>American University of Cairo: Smart Embedded Components and Systems, Smart Integrated Systems</p> <p>Heliopolis University (Faculty of Engineering): Complex System Engineering: PV System, Wind energy solutions, Diesel Gen., UPS</p> <p>Ain Shams University (Faculty of Engineering): Smart card design</p> <p>Benha University (Faculty of Engineering): VLSI, Singal Processing</p> <p>South Valley University: Artificial Intelligence</p>
Advanced Computing	<p>Nile University (Center for Informatics Science): Cloud computing; Clouds; Applications Software</p> <p>American University of Cairo: Processor and System Architecture, Parallel Computing and Simulation Software.</p> <p>Heliopolis University (Faculty of Engineering): Simulation Software</p> <p>Egyptian National Scientific and Technical Information Network (ENSTINET): Parallel Computing</p> <p>SECC-ITIDA: Cloud computing</p> <p>Helwan University: Computational linguistics; Speech; Distributed computer systems Computer Networks and Communications</p> <p>Aswan University (Dept. of Engineering): Millimeter Waves, Congitive Radio</p>
Future Internet	<p>Cairo University (Depts of Information Technology, Computer Science, Electrical and Communication): Optical and wireless networks. Skills include: High-speed interconnection networks for Data Centers, LTE-Adv</p>

	<p>Systems. Participated in the 4G (LTE) project funded by the National Telecom Regularity Authority (NTRA) of Egypt. Wireless sensor networks, Cloud Computing, IoT.</p> <p>Helwan University (Faculty of Computers and Information Systems): Human Computer Interaction, Cloud Computing, Data Mining, High Performance Computing, Mobile Computing</p> <p>Nile University (Software Engineering Program, Information Security Program, Wireless Intelligent Networks Center, Nano electronics Integrated Systems Center, Center for Informatics Science): Software Engineering, Cloud Computing, Wireless Communication, Wireless Intelligent Networks, Peer to peer Networking, Cognitive communication, Wireless sensor networks, Wireless security, Information Security</p> <p>American University of Cairo: Networks, Software and Services, Cloud Computing, Cyber Security, Privacy and Trust</p> <p>National Telecommunication Institute: Networks, Cloud Computing, Cyber Security, Wireless Communication and Optical Networks</p> <p>Egyptian National Scientific and Technical Information Network (ENSTINET): Networks, Cloud Computing, Cyber Security, Privacy and Trust, Wireless Communication and All Optical Networks, Immersive Interactive Multimedia and Connected Enterprise</p> <p>British University in Egypt (Faculty of Informatics and Computer Science): Cloud Computing</p> <p>Arab Academy for Science, Technology & Maritime Transport: High Performance Computing including Grid and Cloud Computing, Communication Antennas, Networks</p> <p>Alexandria University: 4/5G (LTE) wireless systems, Cognitive radio networks.</p> <p>ITIDA - SECC: IoT</p> <p>Mansoura University: Cloud Computing</p> <p>Zagazig University: Wireless Sensor Networks, Cloud Computing</p> <p>Menofiya University: Optical communication, Femtocell, Heterogeneous networks, Wireless sensor networks</p>
Content Technologies & Information Management	<p>Helwan University (Faculty of Computers and Information Systems): Computational Linguistics, Data Management, Conceptual Mapping, Knowledge Engineering, Computer Arabization and Islamic applications, Speech Processing and Machine Learning</p> <p>Nile University (Center for Informatics Science): Data Mining and Machine Learning, text mining, High Performance Computing, Peer to Peer Networking, ubiquitous computer, computing vision, language</p>

	<p>processing systems; Computational linguistics; Social networking (online) General Computer Science</p> <p>American University of Cairo: Technologies for Language, Learning, Big Data Technologies' Advanced Data Mining, Machine Learning, Statistical Analysis and Visual Computing</p> <p>Egyptian National Scientific and Technical Information Network (ENSTINET): Big Data Technologies, Advanced Data Mining</p> <p>Azhar University (Computer Engineering Dept): Natural Language Processing, Content Technologies & Analysis</p> <p>Arab Academy for Science, Technology & Maritime Transport: Data mining, eLearning, Informatics</p> <p>Cairo University (Faculty of Computer Information): Information Management including Big Data, Content Management and Content Technologies, Semantic web and semantic computing</p>
Robotics	<p>Nile University (FACT (Festo Authorized Automation and Certified Training Center) for training in Mechatronics and Automation, Center for Informatics Science): Robotics</p> <p>Mansoura University (Engineering Dept): Robots Mechanical Engineering; Control and Systems Engineering</p> <p>Ains Shams University (Engineering Dept): Robotics</p> <p>Assiut University (Engineering Dept): Robotics</p>
Key Enabling Technologies: Micro - Nano- electronics and Photonics	<p>Nile University (Nano Electronics Integrated Systems Center, Center for Nanotechnology): Micro-Electro-Mechanical devices, Nanoelectronics Integrated Systems, sensor and actuator design, many core chip design, bio-chips and lab on a chip, printed electronics, membrane technology</p> <p>Helwan University (Engineering Dept): Nanoparticles; Titanium dioxide General Materials Science; Electrical and Electronic Engineering</p> <p>Ains Shams University (Engineering Dept): Thin films; Films; Optical properties Condensed Matter Physics; Electronic, Optical and Magnetic Materials; General Materials Science, Optical tomography; coherence; tomography Atomic and Molecular Physics, and Optics; Electrical and Electronic Engineering.VLSI circuits; Mapping; Communication Hardware and Architecture</p> <p>Benha University: VLSI, Singal Processing</p> <p>National Research Center: Nanopartciles</p> <p>Cairo University: Nano-electronics</p> <p>Suez Canal University: Magnetic Nanoparticles</p>

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>Nile University (Center for Informatics Science, Center for Nanotechnology): Medical Image Processing, bio-informatics</p> <p>American University of Cairo: Improved diagnostics, Expert Systems and Knowledge Discovery</p> <p>British University in Egypt (Faculty of Informatics and Computer Science): Mobile-based Health applications</p> <p>Assiut University: Medical diagnosis systems.</p> <p>Cairo University: Cloud-Based Platform for Advanced Processing of Cardiac Imaging, 4D imaging systems, RFID-based positioning in hospitals.</p> <ul style="list-style-type: none"> • Thermography (temperature measurement); Thermography (imaging); SportS Biomedical Engineering; General Computer Science; Software • Fuzzy logic; Biomedical equipment; Hospitals Control and Systems Engineering; Electrical and Electronic Engineering • Brain; Tumors; Magnetic resonance imaging Radiology, Nuclear Medicine and Imaging; Signal Processing • Image segmentation; Liver Electrical and Electronic Engineering; Civil and Structural Engineering; Cancer Research <p>Helwan University: CAD for breast cancer.</p>
Food Security, Sustainable Agriculture	<p>Nile University (Center for Informatics Science): Bio-informatics</p> <p>Heliopolis University (Heliopolis Academy Lab for Biodynamic Agriculture and medicinal plants): Sustainable Agriculture, Sustainable and Competitive Agri-food Sector</p> <p>National Research Centre (Nutrition Dept): Food Security, Sustainable Agriculture</p> <p>Egypt-Japan University of Science and Technology (E-JUST): Intelligent Irrigation Systems</p> <p>South Valley University: groundwater; GIS; zone Water Science and Technology; General Earth and Planetary Sciences; Paleontology.</p> <p>Cairo University: food security, biofood, food safety</p>
Secure, Clean and Efficient Energy	<p>Nile University (Nano Electronics Integrated Systems Center, Center for Nanotechnology): Renewable Energy, Smart Electricity grids, wireless electricity, energy harvesting.</p> <p>American University of Cairo: Renewable Energy, Energy</p>

	<p>Efficiency, Smart Cities (Worked on project funded by Ericsson to manage Traffic Signals using ICT in a city)</p> <p>Heliopolis University: Alternative Fuels and Mobile Energy Sources</p> <p>Electronics Research Institute (ERI): Wind; Hybrid systems; Costs Renewable Energy, Sustainability and the Environment</p> <p>National Research Institute (NRI): Hydrogen production; Hydrogen; Fermentation Renewable Energy, Sustainability and the Environment; Environmental Engineering; Pollution</p> <p>Cairo University: Oxidation; Electrodes; Cyclic voltammetry Electrochemistry (60.8); Renewable Energy, Sustainability and the Environment; General Materials Science</p> <p>Helwan University: Wind turbines; Turbines; Aerodynamics Renewable Energy, Sustainability and the Environment; Mechanical Engineering</p> <p>Mansoura University: Beam propagation method; Waveguides; Solar cells Electrical and Electronic Engineering; Electronic, Optical and Magnetic Materials</p> <p>Assuit University: Wind power; Wind turbines; Wind Electrical and Electronic Engineering</p> <p>Ain Shams University: Wind power; Wind; Permanent magnets Electrical and Electronic Engineering, Solar cells; Titanium dioxide; Conversion efficiency</p> <p>Benha University: Geothermal fields; geothermal system; thermal spring Renewable Energy, Sustainability and the Environment; Geology; Geophysics</p>
Climate Action, Resource Efficiency and Raw Materials	<p>Nile University (Nano Electronics Integrated Systems Center, Center for Informatics Science): Wireless Sensor Networks (MEMS sensors)</p> <p>Heliopolis University: Eco-Innovation, Sustainable Management of Natural Resources, Transition Towards a Green Economy</p>
Transport	<p>National Telecommunication Institute: Smart Transport Systems</p> <p>Helwan University: Intelligent transportation management.</p> <p>Assiut University: Tackling urban road congestion</p> <p>Nile University: Advanced traffic management systems</p> <p>E-Just: Traffic estimation system</p>
Inclusive, Innovative and Reflective Societies	<p>Nile University: Social entrepreneurship</p> <p>Heliopolis University: eLearning, eCulture</p> <p>Bibliotec of Alexandria (CULTNAT): Heritage Visualisation, Cultural Heritage</p>

	Electronics Research Institute (ERI): Learning systems; Algorithms; Students Information Systems; Education
Secure Societies	<p>Nile University (Center for Informatics Science, Information Security graduate program): Information Security -risk and management.</p> <p>American University of Cairo: Cyber Security</p> <p>Cairo University: Chaotic systems; Chaos theory; Cryptography Electrical and Electronic Engineering; Applied Mathematics</p> <p>Helwan University: Watermarking; Digital watermarking; Image watermarking Electrical and Electronic Engineering; Computer Networks and Communications</p> <p>Electronics Research Institute (ERI): Cryptography; Authentication; Electronic document identification systems Computer Networks and Communications; Computer Science Applications</p> <p>Suez Canal University (Dept. of Engineering): Cryptography</p> <p>Menofiya University: Cryptography</p>

Level of Research Maturity

Egypt has a vibrant research community with strong experience of collaborative research having secured participation in over **101** projects and securing research funding of over **€16 million** under FP7.

Up to September 2018, Egypt is involved in **34** Horizon 2020 projects with research funding of over €3.475 million across a number of thematic areas:

- LEIT-SPACE H2020-Galileo-2014-1 - **BEYOND** (CSA - Coordination & support action) - Arab Institute of Navigation
- SOCIETY, H2020-INT-INCO-2014 - **MERID** (CSA - Coordination & support action) - Ministry of Higher Education and Scientific Research)
- MSCA-SUPPORT, H2020-MSCA-NCP-2014 - **Net4Mobility** (CSA - Coordination & support action) - Academy of Scientific Research and Technology ASRT
- Science with and for Society, H2020-GARRI-NCP-2014-1 - **SiS.net2** (CSA - Coordination & support action) - Academy of Scientific Research and Technology ASRT
- INFRA, H2020-EINFRA-2015-1 - **VI-SEEM** (RIA - Research and Innovation action) - Bibliotheca Alexandrina Library of Alexandria Bibalex
- H2020-SC5-2015-one-stage - **GEO-CRADLE** (CSA - Coordination & support action) - Centre for Environment and Development for the Arab Region and Europe
- H2020-INT-SOCIETY-2015 MedReset - Research and Innovation action) Cairo University

- H2020-INT-SOCIETY-2015: **FEUTURE** (RIA - Research and Innovation action) - The American University in Cairo;
- H2020-SFS-2015-2 - **IMAGE** (RIA - Research and Innovation action) - The Agricultural Research Center
- H2020-WATER-2015-one-stage - **WaterWorks2015** (ERA-NET-Cofund) - Academy of Scientific Research and Technology Asrt
- H2020-ISIB-2015-2 - **SIMRA** (RIA - Research and Innovation action) - Cairo University
- H2020-WATER-2015-two-stage - **MADFORWATER** (RIA - Research and Innovation action) - Ministry of Water Resources and Irrigation
- H2020-INT-INCO-2015 - **5TOI_4EWAS** (CSA - Coordination & support action) - Academy of Scientific Research and Technology Asrt; National Research Center)
- H2020-SC5-2016-OneStageA - **4PRIMA** (CSA - Coordination & support action) - Ministry of Higher Education and Scientific Research
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA - Coordination & support action) - Information Technology Industry Development Agency)
- H2020-SFS-2016-1 - **LEAP-AGRI** (ERA-NET-Cofund) - Ministry of Higher Education and Scientific Research)
- H2020-SFS-2016-2 - **MedAID** (RIA - Research and Innovation action) - National Institute of Oceanography and Fisheries
- H2020-MSCA-RISE-2014 - CLUSDEV MED (MSCA-RISE) - Academy of Scientific Research and Technology Asrt
- H2020-MSCA-RISE-2014 - ECOFISH (MSCA-RISE) - The Agricultural Research Center and Kafr El-Sheikh University
- H2020-MSCA-RISE-2014 - NonMinimalHiggs (MSCA-RISE) - Zewail City of Science & Technology
- H2020-MSCA-RISE-2014 - GLYCANC (MSCA-RISE) - Cairo University
- H2020-MSCA-RISE-2015 - OptArch (MSCA-RISE) - Cairo University
- H2020-MSCA-RISE-2015 - TACTILENet (MSCA-RISE) - Nile University
- H2020-MSCA-RISE-2016 - trans-making (MSCA-RISE) - Cairo Lab for Urban Studies Training & Environmental Research Cluster
- H2020-BG-2016-2 - ODYSSEA (RIA) - Arab Network for Environment & Development
- H2020-MSCA-RISE-2016 - CURE-XF (MSCA-RISE) The Agricultural Research Center
- H2020-SFS-2017-1 - ForestValue (ERA-NET-Cofund) - Academy of Scientific Research and Technology Asrt

- H2020-SC5-2017-OneStageB - WaterWorks2017 (ERA-NET-Cofund) - Academy of Scientific Research and Technology Asrt
- H2020-MSCA-RISE-2017 - DiCoMI (MSCA-RISE) - Central Metallurgical Research and Development Institute
- H2020-MSCA-NCP-2017 - Net4MobilityPlus (CSA) - Academy of Scientific Research and Technology Asrt
- H2020-RUR-2017-2 - NEXTFOOD (RIA) - Sekem Development Foundation - Sdf
- H2020-CIRC-2017TwoStage - HYDROUSA (IA) - Heliopolis University Association and Isis For Food Industries, Ltd
- H2020-MSCA-RISE-2015 - InvisiblesPlus (MSCA-RISE) Zewail City of Science & Technology
- H2020-SFS-2018-1 - LEAP4FNSSA (CSA) Zewail City of Science & Technology

To better understand and validate the research capacity of the various organizations in Egypt, ITIDA (SECC) adopted the SciVal tool developed by the Elsevier publisher to analyze the publications of the staff of the universities and the research institutes in Egypt. For each theme in the H2020, all researchers in the institutes related to this theme were identified and their publication and research history along with the various standard metrics of scientific publications (including citation and h-index). After the review, the institution was included in the data as an institute with capacity in this area/theme.

A great deal of work has been carried out in areas including Incubators to build links between universities and entrepreneurial commercialisation of research. Quite a few international technology companies have operations in Egypt, which clearly provides an additional emphasis to innovation already driven by Egypt's increasingly important software industry. While there is a clear focus on technology adoption and developing applications, there is a strong research tradition in many of the Egyptian universities.

5.5 Innovation Spaces

Innovation Spaces gradually emerged in Egypt from 2009 and the numbers have steadily grown. Unfortunately, not all are still operating (e.g., Tahrir Square hub, Cairo Hackerspace, Plug and Play Egypt, El-Minya Hacker space). Most Innovation Spaces in Egypt are located in Cairo or Giza (just outside Cairo) with a small number also located in the famous port city of Alexandria. *The District Co-working Spaces*²¹³, American University of Cairo (AUC) Venture Lab and *icecairo*²¹⁴ are all located in downtown Cairo, while the Technology Innovation & Entrepreneurship Center (TIEC), UNTIL Lab, Smart Village, Flat6Labs²¹⁵, Fab Lab Egypt²¹⁶, and Giza Hackerspace are all located in Giza. icealex and Alexandria Hackerspace are located in Alexandria.

²¹³ <http://www.district-egypt.com>

²¹⁴ <http://www.icecairo.com>

²¹⁵ <http://www.flat6labs.com/location/cairo>

They range in focus from Pre-Incubation (icecairo, icealex, *Alexandria Hackerspace*²¹⁷), Incubation (American University of Cairo (AUC) Venture Lab, Technology Innovation and Entrepreneurship Center – TIEC²¹⁸, Flat6Labs, GESR Incubator and Innovation Lab, Nahdet El Mahrousa²¹⁹, Sustaincubator) and Accelerator (Flat6Labs, Injaz Egypt, Sustaincubator) and Co-working and meeting spaces (The District, Fab Lab Egypt Giza Hackerspace, Al Maqarr, Muqaddima Coworking Space - GrEEK CAMPUS²²⁰, Rasheed22, 302labs²²¹, Innoventures Startup Circus). Some innovation centres focused on specific issues, for example Ebni which focused on incubation and acceleration around hardware innovations and Sustaincubator, which is specifically supporting innovation in Food, Renewable Energy and Water.

As part of its plan to promote young talent, MCIT cooperated with the Ministry of Higher Education to establish 8 technology innovation hubs within Egyptian universities to train university senior students within the faculties of engineering and computers and information technology as well as recent graduates. This is in addition to nurturing young people's creativity and supporting young entrepreneurs through innovation hubs and accelerators, and incubators for small and micro enterprises, which in its entirety represent an integrated system for nurturing and supporting the ideas of youth and their projects within each regional university. These 8 universities are considered as Phase 1 of this national initiative. More universities are planned for 2019. The target is to include all the 26 national governmental institutes within the initiative over the next 2 years.

Some are described in more detail below.

STARTUPS OF ALEX²²² is the first Alexandria based incubator launched by icealex (focusing on co-working space, mentoring, training) and funded by the Academy for Scientific Research and Technology under the program of "Intilac National Incubators". STARTUPS OF ALEX aims to connect key stakeholders across the Alexandrian startup ecosystem, including startups with mentors, investors, partners and supporting organizations such as co-working spaces and innovation & technology hubs.

EITESAL Business Nurturing Initiative (Ebni) is now part of the Borg Al Arab Innovation Cluster, based in the Silicon Waha Bog Al Arab Technology Park. This park is supported by EgyptInnovate, ITIDA, Silicon Waha, the Ministry of Communications and Information Technology and USAID. Ebni provides access to seed grant funding, rent free co-working space, access to prototyping space as well as access to technical and business support and accounting and legal services.

²¹⁶ <http://www.fablab-egypt.org>

²¹⁷ <http://www.alexhacker.com>

²¹⁸ <http://tiec.gov.eg/>

²¹⁹ <http://nahdetelmahrousa.org/contact-us>

²²⁰ <http://www.thegreekcampus.com/>

²²¹ <http://www.302labs.com/>

²²² <http://startupsofalex.com/>

The District was established in November 2011 as a commercial co-working space for established entrepreneurs after the ideation stage, offering co-working space, private meeting space, Internet access, and since October 2013, a café. As well as offering paid training programmes onsite, The District received support from the Dutch Embassy to launch an entrepreneur support programme in September 2014 focused on knowledge transfer and peer-to-peer skills sharing.

Affiliated with the international co-working space company **icehubs**²²³ and the **AfriLabs Network**²²⁴, **icecairo** was established in 2012 as a not-for-profit green-tech innovation hub, with a focus on both services delivered via a physical venue (with Internet access, co-working and meeting space, fab-lab facilities, events, training and the GIZ Responsible & Inclusive Business Hub funded under the GIZ Employment Promotion Programme) as well as online, including a blog and online training. Icecairo is “focused on turning environment and social challenges faced by Egyptian communities into opportunities for the creation of green businesses.” icecairo has been heavily dependent on funding from GIZ and is trying to diversify revenue streams to achieve sustainability.

The **Technology Innovation and Entrepreneurship Center (TIEC)** was established in September 2010, focusing on pre-incubation, incubation, acceleration and entrepreneurship and business support. To date, it has incubated 32 companies and supported over 100 startups and early stage companies, and is currently incubating 16 entrepreneurs, half graduates, half experienced professionals. Government funded, it has a national mandate to “stimulate an innovation-based economy through promoting innovation, supporting entrepreneurship and the creation of intellectual property in the ICT field. In November 2018, TIEC has established its IoT labs, which are equipped with latest IoT devices, tools and platforms that support different IoT verticals. The labs aim to be an IoT playground for students, innovators and experts to learn, develop, and pilot their IoT use cases and to collaborate on countrywide IoT solutions. Currently, the operational model for the lab is being approved. The lab will be open to the community in Q1 of 2019.

The **United Nations African Technology Innovation Lab (UNTIL)** was opened in Egypt in November 2018. It is hosted by the Technology Innovation and Entrepreneurship Centre (TIEC). The Lab will facilitate training on technology innovations to develop solutions that address global challenges. Thematic areas that it will focus on include: Education for special-needs students; Health: disease control, epidemic prevention, and therapeutic tourism; Industry: circular economy through value-chain development and waste management, Agriculture: animal production, poultry farming, aquaculture, water rationalization, and soil fertility. It is envisaged that all solutions will be open source using open data.

Al Maqarr was established in 2012 and focuses on co-working space. It now has three locations (Greek Campus and Heliopolis, Cairo and G Space – ElGouna, Hurghada).

²²³ <http://www.icehubs.com>

²²⁴ <http://www.afrilabs.com>

AUC Venture Labs (V-Lab) was established by the American University of Cairo in 2013, as the first university-based incubator in Egypt. It incubates early-stage and growth-stage startups providing training sessions, mentors, student internships and engagement with the AUC School of Business. In 2014, AUC V-Lab has been selected among the top five most promising university incubators in Africa by Sweden-based UBI-Index. Currently 5+ startups are supported by AUC venture lab.

Flat6Labs is a regional startup accelerator program that provides seed funding, strategic mentorship, a creative workspace, entrepreneurship-focused business training, and access to investors. Flat6 labs has now 4 locations, 80+ mentors, 180+ entrepreneurs, 75 companies benefited from the acceleration program with 400+ jobs created.

1864²²⁵ is Egypt's first dedicated fintech accelerator. Run by Flat6labs in partnership with Barclays Bank Egypt, it offers funding of up to 150,000 Egyptian pounds (US\$16,800) in exchange for a minority stake of 10-15 percent. It offers office space and free legal advice.

GESR is a technology-based, social business incubator focused on Water, Energy, Food, Health and Education. It provides both an Incubation and Acceleration programme. Funded by the Misr El-Kheir Foundation, the Incubation programme includes a one year incubation period and funding up to 500,000 LE for registered social enterprise with a functional prototype, a vision of the target market, and a solid business plan. The Acceleration programme includes a six month incubation period and funding up to 200,000 LE to support social entrepreneurs to develop their prototype further. The lab includes a mechanical workshop and embedded systems lab. Innovators are provided with co-working space, technical support, hand tools and electronic kits.

Fab lab Egypt is a not-for-profit, co-working space and digital fabrication Lab, and member of MIT Fab Lab Global Network. Established in 2012, it offers paid access to co-working space, machines and tools for digital fabrication and prototyping, hands-on MIT accredited curriculum-based training, workshops and events.

Sustaincubator is an incubator focusing on innovative sustainable development in the areas of water, food, renewable energy and IT-enabled solutions supporting sustainable causes.

INJAZ Egypt²²⁶ provides incubation and acceleration services for about 29 companies. Established in 2003, INJAZ Egypt works to promote the skills of employability and entrepreneurship among Egypt's unemployed youth in partnership with businesses and educational institutions across the country.

302 Labs is a co-working space which supports networking and community activities including hackathons and workshops.

²²⁵ <http://www.1864accelerator.com/>

²²⁶ <http://injaz-egypt.org/>

6. ETHIOPIA

6.1 Introduction

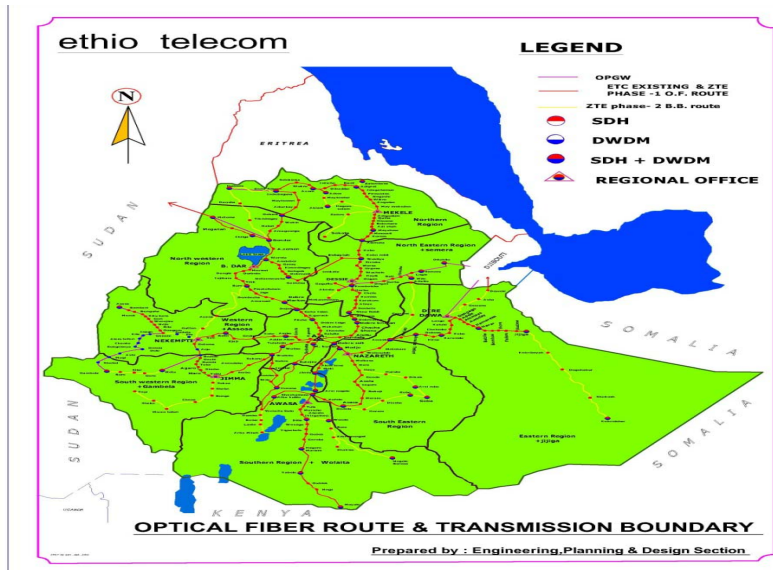
Ethiopia is situated in Eastern Africa and shares boundaries with Somalia, Kenya, South Sudan, Sudan, Eritrea and Djibouti. It has a surface area of 1,104,300 square kilometres and is a federal state with nine regional states and two city administrations. Its population is estimated at 108.39 million inhabitants (July 2018, CIA World Fact Book) with a literacy rate of 49.1%. Ethiopia is Africa's oldest independent country and its second largest in terms of population. Almost 54% of the total population is between 15 - 64 years of age. Addis Ababa, the capital city, has a population of 4.4 million (2018 CIA World Factbook). Although Amharic is the official language of Ethiopia; English and Arabic are widely spoken.



Ethiopia is a multi-ethnic society. The climate is tropical monsoon with wide topographic-induced variation due to its terrain. In terms of natural resources, there are small reserves of gold, platinum, copper, potash, natural gas and hydropower.

Ethiopia is one of the fastest growing non-oil economies in Africa. It is heavily dependent on agriculture (accounts for 34.8% of GDP and 70% of total employment), which is often affected by droughts (2018, CIA World Factbook). Coffee is its major export crop.

In terms of ICT infrastructure, Ethio Telecom provides telecommunication services. There is an open-wire, microwave radio relay, radio communication in the HF, VHF and UHF frequencies. Two domestic satellites provide the national trunk service (2011). There is 14,000 km optic fibre cable infrastructure starting from central Ethiopia to all directions of the country and connected all cities with a capacity to transmit 40 Gbps along with the national backbone.



According to Ethio Telecom as at November 2018, there were 1.23 million fixed telephone lines in use, 65.7 million mobile phone users and 17.87 million Internet users with 85% wireless coverage

across Ethiopia. MCIT has established 300 Community Information Centres and 12 community radio stations to date in remote areas of the country to provide information on new ICT technology transfer and implementations, healthcare, agricultural information and education issues. There is a Government call centre that citizens can ring via a toll free number and discuss their queries in relation to Government Ministries and Departments. The framework for the National Public Key Infrastructure (PKI) is completed and has now moved into the implementation phase.

There are 45 public universities and 45 private institutions of higher education across the country. The Government introduced the 'ICTs in Education Implementation Strategy and Action Plan' in 2010 as one of the pillars of the ICT4AD Plan to address the rural-urban divide in Ethiopia in terms of access to computer in education.

6.2 ICT Background

In line with its ambition to become a middle-income country by 2025, Ethiopia has embarked on a number of national programmes and views its ICT policy, which was revised and endorsed by the Council of Ministers in 2017, as an integral part of the country's larger development goals and objectives.

The Ethiopian ICT Strategy proposes that the country advances its ICT Research and Development by putting key enablers in place such as building a state-of-the-art broadband network that supports academic and research networking, improving the incentives for academic institutions and the private sector to promote ICT research and development and addressing key cross-cutting challenges such as coordination, collaboration, women empowerment and financing. The success of Research and Development for the ICT sector requires private public partnership, commitment by the Government to provide the appropriate legal framework and conducive environments for Research and Development. The Government, universities and research institutions need to actively engage in the implementation of the strategy by availing the necessary human and financial resources and embracing partnership.

Ethiopia's National ICT Policy was first drafted and submitted to the Council of Ministers in 2002. The key vision was to improve the social and economical well-being of the people of Ethiopia through the exploitation of the opportunities created by ICT, for vitalising and ensuring the establishment of a sustainable democratic system and good governance as well as for achievable, sustainable and rapid socio-economic development. It was subsequently revised in 2017.

The Ethiopian ICT Development Authority (EICTDA) was established in 2003 with a primary goal of completing and implementing the ICT Development Policy. One of the main pillars of the policy was the e-Government Strategy, which implemented 211 eServices (75 informational and 133 transactional) over a five-year period. Priority Services include: eAgriculture, eEducations, eHealth, eTrade, Employee Management, eTransport, Social Benefit Management, eTourism, eTax, eCourt, eMunicipality, Unified Billing System (UBS), Passport and Visas.

The National ICT Policy and Strategy 2009²²⁷ planned to leverage knowledge and information as a tool for socio-economic development as well as promote and enhance the ICT sector and its contribution in Ethiopia's political, social and economic transformation. Its key objectives were to:

- Build an accessible ICT infrastructure throughout the country;
- Create the necessary skilled human resources requires for the proper development and application of ICT and expand the society's basic knowledge and usage of it;
- Develop the necessary legal framework for the application of ICT and design and implementation appropriate security systems for the prevention of unlawful practices
- Promote the use of ICT for modernizing the civil and public services to enhance its efficiency and effectiveness for service delivery; so as to promote good governance and reduce wastage of resources; and
- Expand and strengthen the role of the private sector to ensure the rapid development of ICT

The Ministry of Communication and Information Technology (MCIT) was established pursuant to Proclamation No.691 in October 2010 to strengthen the institutional framework for undertaking policy planning, development and implementation of ICT initiatives in a coordinated manner. MCIT is a result of the merger of three previous agencies: The Ethiopian Information and Communications Technology Development Agency (EICTDA), The Ethiopian Telecommunications Agency (ETA) and the Communication wing of the former Ministry of Transport and Communications.

The Ministry was responsible for promoting the expansion of communication services and the development of Information Technology; setting and implementing standards to ensure the provision of quality, reliable and safe communication and information technology services; regulating the rate of telecommunication service charges; Licensing and regulating telecommunication and postal service operators; facilitating the creation of institutional capacity for the effective implementation of information technology development policy; assigning and monitoring government domain names and coordinating all stakeholders for the creation and proper utilization of country code top level domain, and facilitate the proper implementation of same; facilitating the creation of fast and affordable information access; follow up, and provide necessary support for the implementation of modern information network between and within federal and regional government institutions and ensure mission critical systems and services in public sector are computerized and online services are gradually available to users.

The Ministry consisted of the following Directorates: Capacity Building Directorate; E-Government Directorate; Standard and Regulatory Directorate; ICT Private Sector Development Coordination Directorate. The Capacity Building Directorate among other responsibilities is responsible for supporting ICT Research and Technology Development and guiding, supporting and coordinating national ICT HR and ICT RTD in line with national socio-economic development priorities.

²²⁷ http://www.mcit.gov.et/sites/default/files/ICT%20Policy_final.pdf

As a result of a government overhaul, which commenced in July 2018, there were discussions to reduce the number of members of the Council of Ministries and merge some Ministries. In October 2018 the Ministry of Science and Technology and Ministry of Communication and Information Technology were merged into a Ministry of Innovation and Technology.

The National Science, Technology and Innovation (STI) Policy (2012)²²⁸ was formulated by the Ministry of Science and Technology to support rapid learning, adaptation and utilization of effective technologies by 2022. It aims to create a technology transfer framework that enables the building of national capabilities in technological learning, adaptation and utilization through searching, selecting and importing effective foreign technologies in manufacturing and service providing enterprises.

The major objectives of the STI policy are to:

- Establish and implement a coordinated and integrated general governance framework for building STI capacity;
- Establish and implement an appropriate national Technology Accumulation and Transfer (TeCAT) system;
- Promote research that is geared towards technology learning and adaptation;
- Develop, promote and commercialise useful indigenous knowledge and technologies;
- Define the national science and technology landscape and strengthen linkages among the different actors in the national innovation system;
- Ensure implementation of STI activities in coordination with other economic and social development programs and plans;
- Create conducive environment to strengthen the role of the private sector in technology transfer activities sustainably.

The key policy issues include technology transfer, human resource development, manufacturing and service providing enterprises, research, financing and incentive schemes, national quality infrastructure development, universities, research institutes, TVET institutions and industries linkage, intellectual property system, science and technology information, environmental development and protection, and international cooperation.

The ICT Policy was revised in 2017 with financial support from the World Bank. The scope of Ethiopia's ICT policy covers knowledge and information as a tool for development & ICT as a sector or industry. As an enabler of socioeconomic development, ICT also supports Ethiopia's on-going process of democratization and good governance. The major areas of ICT application in the area of democratic governance include on-going programs such as civil service reform, justice reform and decentralization. ICT promotes democratic governance by enabling all citizens to participate in the political process as well as have access to global knowledge and information. Thus, the goal of the government is to ensure that all citizens have equal and equitable access to government services

²²⁸ [http://www.most.gov.et/STI Policy \(English ver\).pdf](http://www.most.gov.et/STI%20Policy%20(English%20ver).pdf)

and to knowledge and information. Hence, the Government has a commitment to accelerate the development of ICT in order to strengthen the on-going process of sustainable development and poverty reduction as well as good governance and democratic system.

ICT is also a key element in achieving the seventeen UN Sustainable Development Goals (SDGs). Goal 9, and its targets, places an emphasis on the role of technological progress and bridging the digital divide to find lasting solutions for both economic and environmental challenges. The revised ICT Policy articulates policy guidelines and describes critical strategic issues for the development of ICT in Ethiopia. The first chapter highlights the status of ICT development in Ethiopia and also expresses the Government's keen interest in the exploitation and application of ICT. It explains the basic principles of the national ICT policy, in terms of ICT vision, mission, goals, objectives and strategies. Hence, the revised ICT policy is focused on the following policy foundation and strategic pillars that are considered the success of ICT development.

1. ICT Policy Foundation: The following foundational elements are essential to underpin all other aspects of the ICT policy a) ICT infrastructure development, b) Human resource development and c) ICT's legal systems and security,

2. ICT Policy Pillars: With the foundation in place, Ethiopia will be in a better position to exploit the potential of ICT in the country, boost ICT-related industries and leverage ICT to usage in the country.

The following key sectors, industries and cross cutting issues constitute the pillars of this policy and are intended to highlight and guide the use of ICT in the transformation of Ethiopian economy and society

a) ICT for governance /E-Government/; especially ICT in the education sector, ICT for improved health and ICT for agricultural modernization

b) ICT industry and private sector development

c) ICT for research and development

d) Computer and related services

e) Entrepreneurship and innovation

f) Youth and Women

To implement the ICT policy foundation and pillars identified above, designed goals, objectives as well as strategies against each of the sectors are well articulated in the revised ICT policy.

6.3 Current ICT Initiatives and projects

ICT Initiatives are primarily focused on eGovernment and Public Key Infrastructure (PKI), eInfrastructure including EthERNet (Ethiopian Education and Research Network), Entrepreneurship and eEducation.

A number of national initiatives have been undertaken over recent years focused on stimulating the use of ICT including: the National Data Set; National Enterprise Service Bus (NESB); Public Key Infrastructure (PKI); EthioICT-Village; WoredaNet; Integrated Financial Management Information System; ICT Business Incubation Centre; EthERNet (Ethiopian Education and Research Network) and SchoolNet.

6.3.1 eGovernment Initiatives

6.3.1.1 National Data Set

This project aimed to provide a national level data set of commonly used data elements across Ministries, which can be used by all inter-ministerial applications as well as channels of delivery (national portal, mobile portal, CSC, NCC etc.) for delivering eServices. The National Open data set Master Plan was completed in 2015. The implementation stage is in progress for seventeen Ministries and agencies.

Coverage: All Ministries and Agencies of Ethiopia

Project Duration: 2014 - September 2015 Master Plan, Implementation stage ongoing

6.3.1.2 National Enterprise Service Bus (NESB)

The objective of this project was to provision a platform for seamless integration of Ministry / agency applications and database at the back end; integrating all front-end channels to deliver eServices. The National Enterprise Service Bus Master Plan preparation was completed in 2015.

Coverage: All Ministry and agency application identified in the eGovernment strategy

Project Duration: 2013 - 2015

6.3.1.3 Public Key Infrastructure (PKI)

The objective of this project is to provide PKI based identification, integrity and non-repudiation for online transactions related to the eGovernment projects in Ethiopia. This project is still ongoing.

Coverage: Nationwide initiative for issuance and use of PKI for all electronic transactions for government and private

Project Duration: Ongoing

6.3.1.4 Open Data Implementation

The project aims to implement open data at national level. The platform is already developed and has sixteen data sets on it. The policy and guideline development is ongoing.

Project Duration: May 2015 - February 2016 (Initial setup)

6.3.1.5 EthioICT-Village

MCIT is in the process of setting up the EthioICT-Village in an area of 200 hectares in Addis Ababa, which aims to establish Ethiopia as the premier IT Hub of Africa. It aims to provide a world-class

business environment along with a conducive policy and regulatory framework, state-of-the-art infrastructure and value proposition. It will incorporate an ICT Business zone, Assembly and Warehouse zone and a Knowledge Park zone.

The EthioICT-Village is going to be developed in two phases. The construction of the first phase with an area of approximately 70 hectares has been completed. More than 20 international and local ICT companies have setup business activities from the IT Park. The second phase of the construction has started in September 2017 and will take 2-3 years.

Funding sources: Government of Ethiopia

6.3.1.6 WoredaNET

WoredaNET is an eGovernment network connecting more than 900 local, regional and federal government offices across the country. It is a terrestrial and satellite based network designed with the primary objective to provide ICT services such as video conferencing, directory, messaging and Voice Over IP, and Internet connectivity to the federal, regional and “woreda” level government entities. The WoredaNet implementation project was part of the broader eGovernment Strategy.

The goal of WoredaNet is to establish a multi-service IP-based service by the use of Terrestrial Broadband and VSAT infrastructure for the delivery of services to government and the citizens. The initiative is aimed towards the improvisation of Federal and Regional Government administrative efficiency, effectiveness and productivity, as well as, information provision and service delivery to the public at large.

The main objectives of the project include:

- To bridge the digital divide between urban and rural communities;
- To provide knowledge and information to citizens;
- To build organizational capacity at all levels of government;
- To provide the lowest level of government with accurate and timely information.

The second phase has commenced.

Geographic scope and frame: All the participating ministries, agencies, regional and local government offices to be covered in the Woreda-net. 216 electronic services (informational and transactional) and more than 25 mobile applications have been developed and operationalised.

Funding source: Government of Ethiopia

6.3.1.7 Integrated Financial Management Information System (IFMIS)

IFMIS enables public institutions to use a single system with extensive facilities from one physical source. This enables the Ministry of Finance and Economic Development (MoFED) to improve the quality of financial decision-making by generating timely financial information. IFMIS is implemented in government offices.

Geographic scope and frame: Regional and Federal Offices

Funding sources: Government of Ethiopia

6.3.1.8 ICT Business Incubation Centre (MICT-BIC)

MICT-BIC was initiated in 2008 under the Information and Communication Technology Assisted Development (ICTAD) Project of EICTDA in cooperation with the World Bank and the German Development Service. The project aims to provide solutions to difficulties that graduates of higher education institutions in Tigray Region, Amhara Region, Oromiya Region and South Nations and Nationalities Region are facing such as finding employment in governmental and private organisations. The main objective of MICT-BIC is to serve as a vehicle for development of competitive ICT based MSEs and foster technology innovation in the above mentioned regions.

The Incubation Programme is targeted at graduates with ICT related business ideas and young companies that are interested in incubation services. MICT-BIC is offering individual advisory and support to develop a comprehensive business plan. In addition, the incubation centre provides a standardized training programme on entrepreneurship, business plan development and incubation services. Currently there are two Incubation centres in Jigjiga and Diredawa, which are commencing activities.

Geographic scope: Tigray Region, SNNP Region, Amhara Region, Diredawa and Somali

Financing sources: Government of Ethiopia, World Bank, German Development Service

6.3.2 eEducation Initiatives

6.3.2.1 EthERNet – Ethiopian Educational and Research Network

EthERNet was initiated in 2001 as part of a national capacity building program to provide connectivity and specialised applications for schools and local governments. It aimed to build and deliver highly interconnected and high-performance networks for Universities and other Educational and Research Institutions in Ethiopia. EthERNet has a network with 20Mbit/sec. Plans have been made to build the next generation network that would provide 10Gbit/sec to each of the public universities while interconnecting them. The Ministry of Education is working with ICT Centre of Excellence (Ethiopia) to build a strong organisational framework for EthERNet.

Geographic Scope and frame: 37 Ethiopian public universities are connected

Funding source: Government of Ethiopia

6.3.2.1 SchoolNet

SchoolNet is a satellite-based network that provides Internet connectivity as well as TV-broadcast educational content to secondary schools across Ethiopia. SchoolNet aims to provide students in rural schools with access to equal learning opportunities to those in urban schools.

The Ministry of Education of Ethiopia launched the SchoolNet Project in 2003 with support from UNDP²²⁹. In 2017, around 1530 schools were connected through this project. The SchoolNet project is ongoing to connect more schools and to provide Internet access.

Geographic scope and frame: high schools, and preparatory Schools, total of 1530+

Funding sources: Government of Ethiopia and UNDP

6.4 National ICT Research Capacity and Priorities for Cooperation

6.4.1 National Priorities

Ethiopia's research and development agenda focuses on incremental approaches and areas that are relevant for economic growth such as core computing, internet technologies, social and economic applications, policy and regulation and the content industry.

National ICT Research Priorities include:

- **Physical Analytics Research in Agriculture**
 - To increase farm productivity
 - Upgrade & expanding the deployed call centre service of farmers
 - Agro-meteorology that can be applied towards crop yield monitoring and optimization.
 - Applying the forecasting of soil moisture and temperature technology, among other things.
 - Applying Water Distribution Management technology-from dam to farm because more than 50% of water is lost during transport
 - Smart Agriculture that enables the delivery of the right amount of water and fertilizer with high spatial and temporal resolution in order to increase crop yield.
 - Institutions involved include: MCIT, MOA, Ethiopia's leading Universities, Industry, TVET Agriculture institutes
- **Physical Analytics Research in Solar Forecasting, Data Centre and Infrastructure**
 - Renewable energy source is already an important part of the power mix. So forecasting technology is used to manage solar energy supply and demand.
 - Data Center research with the MMT (data center infrastructure management solution).
 - One critical question in relation to infrastructure is when and where to perform maintenance, which requires research
 - Institutions involved: MCIT, Ministry Energy, Universities, Industry, TVET institutes
- **Health Care & Life Sciences Research**
 - Focused on Hospitals / Healthcare, Sensors, Controlled Release of Therapeutics
 - Institutions involved: MCIT, MOH, Universities, Health Sector NGO, Industry, TVET Health institutes

²²⁹ https://www.cisco.com/web/about/ac79/docs/wp/Ethiopia_SS_0320a.pdf

- **Natural Language Processing**
- **Indigenous Knowledge**

6.4.2 National Research Capacity

The table provides overview of some of the universities with ICT/Engineering courses:

Institution	Location	ICT/Engineering Department(s)	ICT/ Engineering Teaching Staff	Undergraduate Students	Post-Graduate (Masters, PhD)
Addis Ababa University	Addis Ababa	School of Information Science	25	600	260
Ambo University College	Ambo	Department of Computer Science	47	700	0
Hawassa University	Hawassa		30	950	-
Arbaminch University	Arbaminch	Institute of Technology Department of Computer Science	17 lecturers & 20 Assistant Lecturers	885	30
Adama Science and Technology university	Adama	School of Technology; School of Mathematics & Computing Science	61	2000	69
Haramaya University	Haramaya	College of Computing and Informatics (Department of Computer Science, Information Science, Information Systems, Information Technology, Management Information Systems, Software Engineering)	78	1320	0
Jimma University	Jimma	Institute of Technology Department of Computing	49	939	69
Mekelle University	Mekelle	Ethiopian Institute of Technology	15	120	Not Yet Started
Mekelle University		Department of Computer Science, Information Systems and Information Technology	29	1500	20

The Ministry of Communications and Information Technology organised IST-Africa Stakeholder meeting with ICT stakeholders in Addis Ababa on 05 December 2013, 19 November 2014 and 21 November 2016 focused on ICT-related Research and Horizon 2020. Based on this consultation process, each stakeholder identified their areas of research expertise and track record and has been encouraged to develop an organisational profile. A summary of these findings are provided below:

➤ **Addis Ababa University**²³⁰

The Addis Ababa University (AAU), which was established in 1950 is the oldest and largest higher education institution in Ethiopia, has a long track record of teaching, research and community service activities.

Based on prioritising research, AAU set up an Office of the Vice President for Research and Technology Transfer, which incorporates the Directorate of Research (3 offices focused on Research Capacity Building; Thematic Research, Sponsored Collaborative Grants and Small Grants; and Graduate Research Coordination), the Directorate of University-Industry Linkage and Technology Transfer (2 offices focused on Technology Transfer/Parks, Intellectual Property Rights, Adaptive Research and Incubation Centers; and Research Consultancy Services), and the Directorate of Publications and Disseminations (2 offices - Director for University Press and the office of Research Dissemination).

The IT Doctoral Programme was established in 2008. There are currently 70 PhD candidates and six research tracks.

There are Masters students in the area of Computer Science (100), Information Science (100) and Engineering (100). To date over 120 Master Students have graduated in the areas of Computer Science and Engineering.

- Relevant Depts: Institute of Technology (School of Electrical and Computer Engineering) IT Doctoral Programme, School of Information Sciences
- Research tracks in the IT Doctoral Programme include: Information retrieval; Language Technologies; Software Engineering; Wireless Communication; IP Networking (low power computing) and Information Systems
- Research tracks in the School of Information Sciences for Masters include: eHealth and Health Informatics (in cooperation with University of Oslo); Information Sciences and Computational Linguistics. Research areas of interest include: eHealth, eGovernment and Technology-enhanced Learning
- AAU has long-term partnerships in place with a number of institutions in France, UK, Spain and other EU Member States and has a good track record of FP7 participations (4 projects).

➤ **Arba Minch University**²³¹

Arba Minch University (AMU) is a research university located in Arba Minch, about 500 km south of Addis Ababa. The Department of Computer Science and IT runs a Masters in Computer Science and Masters in Information Technology.

²³⁰ <http://aau.edu.et>
²³¹ <http://amu.edu.et>

- Relevant Depts: Department of Computer Science and IT, Department of Electrical Engineering
- Research areas include: Future Internet, Cloud Computing; Big Data; Security (penetration testing); Technology-enhanced Learning; Language Technologies
- AMU has partnerships in place with a number of institutions in Europe and has been involved in 2 Environment projects under FP7.

➤ **Jimma University²³²**

Jimma University (JU) is a public Higher Educational institution established in December 1999 as a result of the amalgamation of Jimma College of Agriculture (founded in 1952), and Jimma Institute of Health Sciences (established in 1983). The two campuses are located in Jimma city 352 km southwest of Addis Ababa with an area of 167 hectares. JU is Ethiopia's first Innovative Community Oriented Education Institution of Higher Learning. Research is currently ongoing focused on design and implementation of integrated ubiquitous eTourism services for Ethiopia.

- Relevant Depts: College of Engineering and Technology, College of Public Health and Medical Science
- Research areas include: Internet of Things, Language Technologies, IP & Mobile Networking, Health

➤ **University of Gondar²³³**

The University of Gondar was originally established in 1954 as a Public Health College and Training Center (Gondar College of Medical Sciences until 2003). It currently has 21,636 undergraduates, 1,829 postgraduate students and provides 56 undergraduate and 64 postgraduate programs. Masters Programmes are provided in the areas of Computer Science, Information Science, Information Technology and Health Informatics.

- Relevant Dept: Computer Science, School of Technology; Department of Health Informatics, Institute of Public Health
- Research areas include: Information Retrieval, Languages architectures (programming), Wireless Networking, Health Sciences, Agriculture (Crop Production), Water, Environment, Sustainable Energy
- University of Gondar has a partnership with several European institutions and a track record in FP7. The Institute of Public Health is involved in a Horizon 2020 project funded under ICT-39-2015.

²³² <http://www.ju.edu.et/>

²³³ <http://www.uog.edu.et/>

➤ **Haramaya University²³⁴**

Haramaya University is one of the oldest universities in Ethiopia, initially set up as collaboration with the Oklahoma State University in 1952 and then as a College under Addis Ababa University in 1968. In 2004 the Faculty of Technology was added and the Faculty of Computing and Informatics and Faculty of Applied Sciences in 2008.

➤ Relevant Depts: College of Computing and Informatics – Dept of Computer Science, Dept of Information Systems, Dept of Information Science, Dept of Information Technology, Dept of Software Engineering

➤ Research areas include: Data Mining, Information Retrieval, Technology-enhanced Learning, Cyber Security

➤ **Mekelle University²³⁵**

Mekelle University was established in May 2000 as a merger of Mekelle Business College and Mekelle University College. It is located in Mek'ele, 783 kilometers north of Addis Ababa.

➤ Relevant Depts: Ethiopian Institute of Technology, College of Health Sciences, Institute of Geo-Information and Earth Observation Sciences,

➤ Research projects include: MU-IUC Projects (The Flemish Inter-University Council (VLIR) Institutional University Cooperation Program); NORAD Project; HP-UNESCO Brain Gain Project; FP7 Projects (Environment - WAHARA 2011 – 2016, Food Agriculture and Biotechnology - EAU4FOOD 2011 – 2015)

➤ **HiLCoE (Higher Learning Centre of Excellence)**

HiLCoE is a private college established in 1998 and offers Undergraduate and Post Graduate Degrees in Computer Science. Following accreditation from the Ministry of Education in September 2009, HiLCoE launched two Masters programs in Software Engineering and Computer Science.

➤ Relevant Dept: School of Computer Science & Technology

➤ Research areas include: Applied research (Tech Transfer); eServices; Information System Security; Environment and Green Technology

➤ **ICT Centre of Excellence**

ICT Center of Excellence (ICTCoE) was formed by the former Ethiopian Information and Communication Technology Development Agency (EICTDA), now the Ministry of Communication and Information Technology (MCIT), and is hosted by the Addis Ababa University (AAU). ICTCoE

²³⁴ <http://www.haramaya.edu.et/>

²³⁵ <http://www.mu.edu.et/>

aims to be a catalyst and an enabler of dramatic progress of ICT in Ethiopia to support socio economic development.

The Center of Excellence aims to utilize innovation based on high quality research and development, training, consulting, and technology transfer, to drive rapid advances of ICT, and its deployment for breakthrough results in national development. ICT CoE will do this by developing networks of partnerships with organizations, both public and private, and local as well as international. These partnerships will enable the CoE to develop into a hub or focal point that will mobilize a wide range of resources.

The Research and Development department is mandated to conduct use-inspired ICT research, produce innovative technologies, carry out market oriented training and/or education of ICT professionals, disseminate relevant state-of-the-art ICT tools and best practices, and provide consultancy services in relevant areas of ICT that are not addressed by other organizations.

➤ Research areas include: Localisation, eLearning, Open Sources Software, Service Management

➤ **Ministry of Education – ICT Directorate**

➤ Research areas of interest include: Cloud Computing, Big Data, Open Source, Technology-enhanced Learning

➤ **Ethiopia Telecom**

➤ Relevant Dept: Network Division

➤ Research areas: eGovernment, eServices, Content Technologies, Future Internet, Advanced Computing

➤ **OSH (Private consulting company)**

➤ Research areas include: Cloud Computing, Green ICT

6.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and discussion during the IST-Africa H2020 Workshop on 19 November 2014 and 21 November 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners include
eHealth / mHealth	Health Information Systems/Electronic Health Records; Maternal, Newborn and Child Health (MNCH); Health diagnosis and Telemedicine; prevention and treatment of Malaria, TB, diabetes and tropical diseases; Mechanisms and alarms to deal with compliance issues (remembering to take medication, attend	Addis Ababa University (School of Information Science); University of Gondar (Department of Health Informatics, Institute of Public Health; Dept. of Computer Science, School of Technology); Debre Birhan

	clinic etc); indigenous knowledge system and Networks to support specific patient groups	University (College of Computing); Jimma University
eAgriculture	Supporting pastoralists; Cloud Computing for Agricultural community	Arba Minch University (Department of Computer Science, Institute of Technology); University of Gondar
Natural Language Processing	Amharic - English eDictionary	Addis Ababa University (School of Information Science)

6.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution and Research area
Future Internet	<p>Addis Ababa University: Wireless Computing, IP Networking</p> <p>Arba Minch University: Future Internet, Cloud Computing</p> <p>Jimma University: Internet of Things, IP & Mobile Networking</p> <p>University of Gondar: Wireless Networking</p> <p>Bahir Dar University, Adama S&T University: Future Internet, Cloud Computing, Wireless Networking</p> <p>Mekelle University (MIT): Wireless Computing, IP Networking, cloud computing</p>
Content Technologies & Information Management	<p>Addis Ababa University: Computational Linguistics & Language Technologies, Technology-enhanced Learning, Information Systems</p> <p>Arba Minch University: Big Data, Technology-enhanced Learning; Language Technologies</p> <p>Jimma University: Language Technologies</p> <p>University of Gondar: Languages architectures (programming), Information Retrieval</p> <p>Haramaya University: Data Mining, Information Retrieval, Technology-enhanced learning</p> <p>ICT College of Excellence: Localisation, Technology-enhanced Learning</p>

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	Addis Ababa University: Health Informatics, eHealth Jimma University: Health Sciences Mekelle University: Health Sciences University of Gondar: Health Informatics, eHealth Ethiopian Health and Nutrition Research Institute
Food Security, Sustainable Agriculture	University of Gondar, University of Haromaya, Mekelle University University of Ambo: Crop Production
Secure, Clean and Efficient Energy	University of Gondar, Mekelle university, Adama University, Adis Ababa University, Addis Ababa Science and Technology University: Sustainable Energy (solar energy, wind & geothermal)
Climate Action, Resource Efficiency and Raw Materials	University of Gondar: Water, Environment Mekelle University: Environment HiLCoE: Environment and Green Technology Arba Minch University Addis Ababa University
Secure Societies	Haramaya University: Cyber Security INSA (Information & Network Security Agency): Cyber Security, Information System Security HiLCoE: Information System Security

Level of Research Maturity

Ethiopia has a good research base and experience of collaborative research with participation in over 23 projects and securing research funding of over **€3.66 million** in funding under FP7 as well as funding secured by 24 individual researchers through Marie Curie Actions. Addis Ababa University, Arba Minch University Mekelle University and University of Gondar have a track record from participation in FP7 projects.

Up to September 2018, Ethiopian organisations have secured participation in 20 Horizon 2020 projects with research funding in excess of €2.278 million across a range of thematic areas:

- SOCIETY, H2020-INT-INCO-2014 - **RINEA** (CSA - Coordination & support action) - African Union
- ICT-39-2015: **mHealth4Afrika** (RIA - Research and Innovation Action) - University of Gondar; **DMC-MALVEC** (RIA - Research and Innovation Action) - Jimma University; **its4land** (RIA - Research and Innovation Action) - Bahir Dar University

- H2020-ICT-2016-INT - **IST-Africa 2016 - 2018** (RIA - Research and Innovation Action) - Ministry of Communication and Information Technology
- H2020-WATER-2015: **WATERSPOUTT** (RIA - Research and Innovation Action) - Mekelle University); **FLOWERED** (RIA - Research and Innovation Action) - Addis Ababa University; Geomatrix Plc)
- ERC-2015-AdG - **BM** - Addis Ababa University
- H2020-MSCA-ITN-2014 - EUROLEISH-NET (MSCA-ITN-ETN) - University of Gondar
- H2020-MSCA-RISE-2014 - DiasporaLink (MSCA-RISE) - Addis Ababa University
- H2020-MSCA-RISE-2014 - IMIXSED (MSCA-RISE) - Jimma University
- H2020-WATER-2015-two-stage - DAFNE (RIA - Research and Innovation Action) - Water and Land Resource Center
- H2020-SFS-2016-2 - InnovAfrica (RIA - Research and Innovation Action) - Haramaya University
- H2020-SFS-2016-2 - MUSA (RIA - Research and Innovation Action) - Southern Nations, Nationalities and Peoples Regional Agricultural Research Institute
- H2020-MSCA-RISE-2016 - SLAFNET (MSCA-RISE) - Addis Ababa University
- H2020-SFS-2017-1 - AfriCultuReS (RIA - Research and Innovation Action) - Geosas Consulting Service Plc
- H2020-MSCA-RISE-2017 - BRTE (MSCA-RISE) - Wolaita Sodo University
- H2020-ICT-2017-1 / ICT-39-2017 - SAMS (IA - Innovation Action) - Oromiya Agricultural Research Institute and iceaddis It Consultancy Plc
- H2020-RUR-2017-2 - NEXTFOOD (RIA - Research and Innovation Action) - Mekelle University
- H2020-SFS-2018-1 - LEAP4FNSSA (CSA - Coordination & support action) - African Union

Some institutions have well developed Masters and PhD Programmes and are looking at collaborative research cross border. The increase in the number of Higher Education Institutions and the Government's emphasis on leveraging ICT are providing strong building blocks for the development of further research capacity in the country.

6.5 Innovation Spaces

Bahir-Dar ICT Business Incubation Center²³⁶ was established in November 2009 in Amhara Regional State in North-Western Ethiopia to support recent graduate ICT entrepreneurs. It provides office space, capacity building and advisory services. The longer-term objective is to develop BICT BIC into a sustainable technology park of over 11,000m². The BIC provides co-working space with Internet access and advisory services focused on around marketing, entrepreneurship and financial management. Funding by the regional government, the facilities are used by startups as well as final year students doing internships.

²³⁶ <http://www.amhara-incubation.org>

iceaddis²³⁷ was established in Lideeta and Kazachise, Addis Ababa (hosted by Ethiopian Institute of Architecture, Building, Construction and City Development (EiABC) and downtown) during 2014 to provide pre-incubation and Incubation support for technology graduates, final year students, professionals and entrepreneurs. iceaddis provides pre-incubation and incubation services, with an emphasis on ICT and green tech. A 12 week business plan training programme is delivered several times a year, with winners securing incubation space. While a social enterprise, most income generated goes to community support. Iceaddis is a member of icehubs and AfricaLabs. Challenges include limited Internet bandwidth and financial support.

EiABC also hosts a FabLab next door. FabLab Addis is being hosted by Addis Ababa University.

xHUB²³⁸ Innovative Society provides co-working space, training and research collaboration and networking opportunities with potential funders, with a particular interest in rural development.

Addis Ethiopia Climate Innovation Center (ECIC)²³⁹ is supported by InfoDev and targets entrepreneurs developing climate mitigation and adaptation solutions. The SNNPRS ICT Business Incubation Center (SICT-BIC) was established in Hawassa city in 2011. Mekelle Information Communication Technology Business Incubation Centre (MICT-BIC) was established in 2008 in Mekelle City.

The **blueMoon Incubator**²⁴⁰ supports youth led innovative, scalable businesses in the agriculture, livestock, fisheries and forestry sectors. Supported companies are located in the **Addis Garage** multi-purpose space in Addis Ababa.

The **Entrepreneurship Development Centre (EDC)**²⁴¹ is a parastatal organisation supported by the Ministry of Urban Development and Housing in partnership with the UN Development Programme (UNDP). Established in 2013, the programme aims to identify growth-oriented enterprises, potential entrepreneurs (including unemployed youth and women) and provide support and training.

²³⁷ <http://www.iceaddis.com>

²³⁸ www.xhubaddis.com

²³⁹ www.ethiopiatic.org

²⁴⁰ <https://www.blumoonethiopia.com>

²⁴¹ <https://www.edcethiopia.org>

7. REPUBLIC OF KENYA

7.1 Introduction

Kenya is situated in East Africa, bordering the Indian Ocean and sharing boundaries with Tanzania, Uganda, South Sudan, Ethiopia and Somalia. It has a surface area of 580,367 square km, made up of forty-seven (47) counties. The population as at July 2018 was estimated at 48.397 million inhabitants with a literacy rate of 78% (CIA World Factbook). 57.88 percent of the population is between 15 and 64 years of age. Nairobi, the capital city, has a population of 4.386 million (2018 - CIA World Factbook). The official languages are English and Kiswahili.



The Government of Kenya through the Vision 2030 Development Blue Print recognises the importance of ICT in economic development and has therefore initiated major steps to promote its use. One of the major initiatives that the Government is pursuing is to improve ICT infrastructure in order to bridge the digital divide and lower the cost of communications. The Government is also levelling the ground through the development and implementation of policy and regulations aimed at attracting investment within the sector. The Government recognises information to be a resource that must be generated, collected, organized, leveraged, secured and preserved to enhance national prosperity.

There are six mobile operators in Kenya: Safaricom Ltd, Airtel Networks Kenya Ltd, Finserve Ltd, Sema Mobile Services, Mobile Pay Limited and Telekom Kenya Limited (Orange). According to Communication Authority of Kenya statistics, mobile penetration is at 97.8% as at June 2018²⁴², with 45.5 million subscriptions compared with 44.1 million in March 2018. Fixed lines have continued to decrease from 23,314 in March 2018 to 23,099 in June 2018. Internet subscriptions stood at 41.1 million in June 2018. .

The ICT sector in Kenya has changed dramatically over the past decade. This has been achieved mainly through increased adoption of ICT products, ICT processing technologies and ICT support services. This has in return increased the demand of ICT related services in the facilitation of other service industries,

In terms of ICT infrastructure, a national fibre optic infrastructure is in place and four submarine cables are online (TEAMS - East Africa Marine System, SEACOM, EASSy - East African Submarine

²⁴² CA Quarterly Sector Statistics Report, April - June 2018

Systems, and LION Optical Fibre Submarine Cable System). The expanded terrestrial fibre optic cable (over 6,000 kms) is complete and linked to the undersea cable. Over the last decade, ICT has outperformed all others sectors growing at an average of 20 percent per year and propelling the combined transport and communications sector into the economy's second largest.: Kenya is recognized as having taken a leading role in using ICT in access to financial services, for example, with the advent of M-PESA an application launched by Safaricom in 2007 access to financial services has significantly increased, with around ¾ of the adult population using mobile money and transfers estimated at US\$7billion annually (20 percent of GDP) by phone.

The number of Higher Education institutions in Kenya has grown considerably over the past three years as a result of greater demand for University Education and the Government policy of enhancing access hence Constituency University Colleges becoming accredited as fully-fledged Universities. There are now 30 fully chartered public Universities, 5 public University Constituent Colleges, 6 public research institutes, 17 accredited private Universities, 11 private Universities with letter of interim authority and 5 private University Colleges.

7.2 ICT Background

There are five key policy documents guiding the ICT and Science, Technology and Innovation (STI) sector in Kenya: Cyber Security Strategy (2014), eGovernment Strategy, Kenya ICT National Master Plan 2017, National Broadband Strategy and Kenya Science, Technology and Innovation (STI) Policy 2012. From a national development program point of view the key policy documents are the Kenya Vision 2030 and the STI Medium Term Plan for 2013 - 2017.

Kenya Vision 2030 was launched in 2008 as a development programme to be implemented in successive five-year Medium-Term Plans (MTP) to transform Kenya into "a middle-income country providing a high quality life to all its citizens by 2030". The Vision is based on three pillars - economic, social and political. The second medium term plan, the (MTP for 2013 - 2017) aims to build on the gains realised by the ICT sector during the MTP I period. The MTP seeks to actualise this by expanding and upgrading ICT infrastructure; improving public service delivery through ICT; upgrading capacities in ICT; and deepening the ICT-related policy, legal and institutional reforms started during MTP I period. Key priorities for the period included include: expansion of the Optic Fibre Networks; establishment of Wide Area Network and Network Operations Centre with outreach to all county headquarters; roll out of 4G connectivity to provide faster internet connectivity and increase bandwidth capacity. Other priorities for the sector included the establishment of a National ICT Center of Excellence; promotion of local ICT software development, roll out of the Digital TV infrastructure to reach 100% coverage; completion of the eGovernment initiatives; enhancement of the Kenya Open Data Initiative (KODI) portal; integration of ICT in education; development of Konza Technology City (KTC) and the establishment of the National ICT Agency.

Vision 2030 Science, Technology and Innovation Sector plan (2013-2017) also identified Telecommunications, Electronics and Computers (TEC) as one of the nine priority thrusts that will

provide the country with technologies and innovations that will develop high-tech vibrant, affordable and globally competitive ICT infrastructure and technology.

In order to support Vision 2030, the Ministry of Education, Science and Technology was mandated to work in partnership with key stakeholders to develop and implement a *Science, Technology and Innovation Policy and Strategic Framework*. The draft Science Technology and Innovation Bill took three years to prepare and the Bill was passed in January 2013. The new Policy aimed to set up three bodies under the State Department in charge of Science, Technology and Innovation:

1. Upgrade the National Council for Science and Technology to the National Commission for Science and Technology²⁴³, which will consult stakeholders to determine STI priorities. It will be responsible for regulation and inspection of research facilities and programmes
2. The Kenya National Innovation Agency²⁴⁴, with offices in all 47 Counties. It will map Innovations, institutionalise linkages between HEIs, research institutes, public and private sector Innovation Stakeholders and provide support focusing on Innovation, Incubation and diffusion. Areas of particular interest include ICT and Mobile Telephony.
3. The National Research Foundation²⁴⁵ to mobilise and manage financial resources to create knowledge, innovation and development in all fields of STI.

In late 2012 the Kenya Parliament indicated a target of up to 2% of GDP would be invested in national research and Innovation going forward. The Government is set to achieve this progressively. The National Innovation Agency and National Research Foundation are now functional and the first and second set of competitive calls for proposals were announced in the 2016/2017 and 2017/2018 financial years respectively.

The ST&I Policy 2012 aims to help facilitate achievement of Kenya Vision 2030 by creating a Knowledge Economy; promote competitiveness in key economic sectors; create enterprises and employment; expand industrialisation; and enhance quality of life through innovation.

During April 2012, the Kenya ICT Authority (previously called ICT Board) launched the Connected Kenya Master Plan, an initiative of the Ministry of ICT to drive aggressive growth in the ICT sector by 2017. Its vision is focused on every citizen being connected, Kenya becoming a leading ICT hub, public services for all and Kenya becoming a knowledge society. The three key intervention priorities are Digital Inclusion, ICT Innovation and Access beyond Broadband.

The Kenya Communications Act (No. 2 of 1998) and Kenya Communications (Amendment) Act 2009 provides the framework for regulating the communications sector. The Information and Communications Technology Sector Policy Guidelines were published in March 2006.

²⁴³ <https://www.nacosti.go.ke>

²⁴⁴ <http://www.innovationagency.go.ke>

²⁴⁵ <http://researchfund.go.ke>

The Communications Authority of Kenya (previously Communications Commission of Kenya (CCK)) is the regulatory authority. The regulatory approach in Kenya is pro-Innovation as demonstrated through support for innovative ICT services like M-PESA. While communication sector liberalisation has had a positive effect on the deployment of infrastructure and services, there are still access gaps in isolated areas where operators cannot envisage ROI. As a result, CA undertook a number of pilot projects to establish 16 school-based ICT centres across the eight provinces, four telecentres and eight centres for people with disabilities. CA also partnered with Kenya Institute of Education to support the digitisation of the secondary school curriculum. Legislation is in place for the Universal Service Fund but the Universal Service Advisory Council needs to be put in place. There then needs to be an engagement with consumers of services and all relevant Ministries to get a multiplier effect. The Universal Services Strategy will provide funding for experts to come up with models for funding. Currently funding mechanisms are scattered, once-off with limited coordination.

In 2013, the Government of Kenya launched the National Broadband Strategy (NBS), which was spearheaded by the Ministry of Information, Communications and Technology (MoICT), in collaboration with the Communications Authority of Kenya (with technical assistance from USAID's Global Broadband Initiative Program). The overall objective of this strategy is to provide quality broadband services to all citizens

7.3 Current ICT Initiatives and projects

There are a wide range of ICT Initiatives and projects ongoing in Kenya focused on eInfrastructure (Konza City, County Connectivity projects, National Fibre Optic Broadband Infrastructure, and Digital Migration), eLearning and Skills development (the Laptop Programme, Digital Learning Programme, Presidential Digital Talent Programme), Digital Inclusion (Pasha Centres/Digital Villages), Business Process Outsourcing, Local Content Programme (Tandaa Digital Content Grants, Open Data Portal), Information Security and Other Initiatives (zero-rated taxes on imported ICT hardware, eGovernment).

7.3.1 Kenya Education Network (KENET)

KENET²⁴⁶ was established in 1999 as a membership institution for educational and research institutions to provide the National Research and Educational Network in Kenya and its vision was enacted in 2001. It is a not-for-profit Trust with seven registered Trustees (five Vice Chancellors, Principle Secretary, Ministry of Education, Director General, Communications Authority) and is governed by a Board of Trustees assisted by a Management Board. It has 88 full Members and is the largest NREN in Africa after TENET in South Africa. It is housed within the Library of the University of Nairobi, with a data centre in the University of Nairobi and a mirror data centre in the United States International University. It provides cost-effective Internet connectivity to its member institutions. It also offers Enterprise Services, Research Services and Capacity Building. There are

²⁴⁶ <http://kenet.or.ke/>

240 campuses across Kenya. All universities and university colleges are connected to KENET except Mount Kenya University. This critical mass allows KENET to have the necessary purchasing power to get value for money on behalf of its members.

KENET is licensed by the Communications Commission of Kenya as an Alternative Network Facility Provider for educational purposes. KENET is managing the largest IP network in Kenya. It is responsible for all nodes and it provides the bandwidth to the gate of the campus. There are currently six points of presence – Nairobi (hosted by University of Nairobi), Mombasa (hosted by Mombasa Polytechnic University), Meru (hosted by Kenya Methodist University), Nakuru (hosted by Egerton University), Eldoret (hosted by Moi University) and Kisumu (hosted by Maseno University). It purchases connectivity in bulk based on a mixture of lease lines from commercial service providers as well as dark fibre, which it lights up. KENET provides hands on training for one year and can also provide certification. There is an equipment node in each University and KENET has empowered technical staff within each university to take responsibility for maintenance of the local area network. KENET manages the link to Amsterdam/London, the circuit and the data centres. It is currently working with the campuses to enable Wireless Infrastructure. It is estimated that there are currently 250,000 students across the country. The wireless networks in the campuses are being designed to support up to 5,000 concurrent users.

The network was built in cooperation with Government investments and the Government of Kenya has provided funds for necessary equipment. The Kenya ICT Authority (previously Kenya ICT Board) procures equipment and hand it over in trust to KENET, who insures it and negotiates with HEIs for the space to install the equipment. KENET is run as a Trust to solve the challenges of its university members and is responsible for running the network on a sustainable not-for-profit basis. Each member institution pays a fee for connectivity based on the capacity required.

KENET had a small infrastructure grant from Google and worked with the Google Cash community aggregating traffic. Google App-s supporting Programs (GASP) is available to universities in Kenya, Ghana, Nigeria, Senegal, South Africa and Uganda. Google is working with Kenyan Universities to provide ubiquitous Internet access and improve the experience of users. Google will match the university's investment on a 1:1 basis up to a predetermined limit for qualifying campus infrastructure projects that improve connectivity for staff and students. Google planned to launch an Internet Measurements Lab during 2013, which will be hosted by KENET. This will provide data and tools to support regulation.

KENET promotes collaboration in STEM research (Health, Agriculture, Education, ICT, Engineering) and ICT-based Research Collaboration opportunities. KENET supports research and innovation champions through sponsorships to participate in international conferences and workshops and collaboration research through mini-grants.

KENET has set up a Shibboleth Identity provider with the support of the ei4Africa FP7 eInfrastructures research team. Shibboleth is a standard based, open source software package for

web single sign-on across or within organisational boundaries. The Shibboleth Identify provider integrates with an LDAP. The Identity Provider will be used for Access to the Africa Science gateway by users in KENET network - KENET is the Registration Authority (RA) for the research community in Kenya. KENET has benefited from the ei4Africa FP7 project's arrangement with CoMoDo (a provider of globally recognised certificates) with free access to one certificate for KENET and KENET member institutions as part of the project. KENET is using this free CoMoDo wildcard certificate for all of its other applications (Websites, monitoring tools and email). KENET promotes the use of official certificates by connected member institutions, not only for research but also for their ERPs and Cloud-based applications. Benefiting from results from the SciGala Open Science Platform project, KENET has build some of the critical research infrastructure components required for a federated Open Scienc Platform.

Through UbuntuNet Alliance, KENET is a beneficiary under Africa Connect and Africa Connect 2 project.

7.3.2 Infrastructure Projects

7.3.2.1 Konza Technology Park

As part of the Vision 2030 Flagship Programmes, the Government of Kenya through the Ministry of Information and Communication plans to set up a technology park at Konza. The main objective of developing an ICT park is to enable to job creation as well as being an avenue to provide the necessary environment to attract investment. It is part of a wider scheme to position Kenya as the region's technology hub, using development to entice more companies to set up base in the country. The park also aims to facilitate business activity within and outside the country, reinforce efficient linkages between the private and public sector, promote the acquisition and usage of ICT in the country and promote good ICT governance. The first phase of implementation is underway with the development of basic infrastructure including water, power, high-speed fibre connectivity with 6 independent back bones.

7.3.2.2 County Connectivity Project

The ICT Authority implemented the county Connectivity project which aimed to ensure that county government offices are connected to the Internet and to facilitate the provision of online services using telephones, emails and teleconferencing. The offices connected included: County Commissioners; treasury department's Civil Registration departments; National Registry Bureau; Education departments and the governor's office. During the first phase 28 countries were connected to teh Government Common Core Network. In Phase 2 the remaining 19 countries were connected and staff trained.

7.3.2.3 National Fibre Optic Broadband Infrastructure (NOFBI)

By June 2013, 4,300 Km of the National Optic Fibre Backbone (NOFBI) Network had been laid in 27 Counties. In June 2016, over 6,000 Km of NOFBI network had been laid across all the 47 Counties. 44 out of 46 OSP and LAN survey in the Counties have been completed. Installation of equipment has been completed in 29 Counties while installation works is in progress in 9 Counties. OSP and LAN had been completed in 29 Counties. Installation is on going in the 12 Counties while 5 Counties are awaiting approval of design and wayleave.

7.3.3 eLearning and Skills development Projects

7.3.3.1 Digital Learning Programme (DLP)

The Digital Learning Programme²⁴⁷ (DLP) was initiated by the Government of Kenya in 2013. It has four components: Technology and Infrastructure, Teacher Training, Digital Content and local assembly. The programme is targeting at learners in all public primary schools and is aimed at integrating the use of digital technologies in learning. The government initiated the program out of the conviction that technology has the power to bring about systemic change in basic and higher education by transforming teaching and learning through integrating technology in the learning environment. The learners are entitled to a luminous green tablet while the teachers receive a blue laptop. In the on-going implementation targeting all public Primary schools in Kenya. Over 75000 teachers in public Primary Schools were trained in readiness for the project implementation. With full implementation of the DLP project, the government expects increased national digital literacy levels and revolution of the countries digital economy.

During the first phase over 1 million devices have been distributed to over 19,000 public primary schools with digital learning materials prepared for Maths, Science, Social Studies, English and Kiswahili. 91,000 teachers have received ICT training. Through the NOFBI project over 6,000kms of fibre has been laid which will assist in providing Internet connectivity to public primary schools. Over 22,000 schools were connected to the grid. As part of the local assembly component, Jomo Kenyatta University of Agriculture and Technology in collaboration with the Ministry of Industrialization established the Nairobi Industrial and Technology Park to assemble devices and Moi University set up an assembly plant in Eldoret. The planning for the second phase of this project commenced in March 2018.

7.3.3.2 Presidential Digital Talent Programme

As part of the Information, Communication and Technology (ICT) Master plan, this program aims to grow ICT leadership and increase the relevance of ICT in business principles in management and public service delivery. It is also aimed at building ICT technical capacity in government for effective

²⁴⁷ <http://digischool.icta.go.ke/>

service delivery. The program provides internship to ICT and engineering graduates. The trainees undergo mentorship in private and public institutions for a period of one year. The first 100 trainees graduated in March 2016, the second group of 400 interns graduated in November 2017 and the third cohort of 400 interns in August 2018. The program aims at achieving workforce development for effective and efficient services delivery leveraging on ICT. The interns have the opportunity to support public services delivery. To date they have assisted in the digitisation of records at the Ministry of Land, supported the implementation of the Digital Learning Programme, provided ICT support to the examinations council and contributed to eGovernment service provision. Huawei has provided sponsorship for the Innovation Awards and has provided network training for the interns.

7.3.3.3 Skills Programmes

In terms of Skills Programs, Kenya ICT Authority is working with Carnegie Mellon University in relation to the Chipuka Software Development Certification, which tests the ability of developers to write and execute code based on skills used in IT companies. This project aims to train 500 developers per year.

On 24 January 2013, the Kenya ICT Authority launched the first government supported ICT Incubation Program on behalf of the Ministry of Information and Communications, with funding of \$1.6 million from the International Development Association of the World Bank as part of the Kenya Transparency and Infrastructure Project. The host incubator was selected through a competitive call and was awarded to Nailab from 2013 - 2016. Nailab provides a 3 – 6 months entrepreneurship program, mentorship and facilities to support ICT start-ups. The incubation program was run in Nairobi, with 24 start ups incubated, of which 19 were in operation by 2016. Initially it was envisaged that virtual incubation services would be provided and a number of hackathons were organised in Mombasa and Kisumu. Challenges were identified in terms of infrastructure, access to mentors and lack of partners to support remote incubation. Nailab set up a seed fund, which provided 4.5 million KES to 11 start-ups (average funding of \$4,000 per start up).

7.3.3 Digital Inclusion Projects

7.3.3.1 Pasha Centres (Digital Villages)

In 2010, the government rolled out an initiative that will diffuse ICT know-how to the rural and marginalized areas to address regional disparities. Entrepreneurs, who run Digital Villages, are awarded loans in a competitive process, which they repay over a period of time. Pasha Centre's as the hubs are called, provide a host of services to the public via computers connected to the internet, or by using and marketing other ICT-enabled applications.

Digital villages are e-centers that provide a suite of services to the public via computers connected to the internet, digital cameras, printers, fax machines and other communication infrastructure. These services include, but are not limited to e-mail, internet access, agency banking, e-banking,

for example, money transfer services such as Posta Pay, eGovernment, for example, police abstract forms, tax returns, and driving license applications, ebusiness, for example, franchised postal and courier services, e-learning, e-health, e-markets, for example, agricultural commodity pricing and exchange and e-monitoring, for instance, real-time local level monitoring of development funds and projects.

The main objective of the centres was to provide Internet access, e-government services and other e-services at the grassroots level via public-private partnerships. The Pasha Centers have been funded through Digital Villages Revolving Fund. So far, 61 Pasha centres are operational.

During the start of Vision 2030 MTP II, the centers were not doing well and a study was commissioned to look the best financing model for this initiative.

7.3.4 Business Process Outsourcing (BPO)/IT Enabled Services

Outsourcing has been identified in the Vision 2030 as a key pillar and driver of social and economic improvement through job and wealth creation. The government has developed a roadmap that will see Kenya take advantage of its unique geographical position and its well-developed ICT human resource base to become the preferred destination for outsourcing in Africa. The 2006 Kenya ICT Strategy and the Vision 2030 development print created the framework for Kenya to focus on global business process outsourcing as a way of generating jobs for young people and generating wealth for local entrepreneurs and investors.

Given the importance of the ICT industry for creating growth and generating opportunities in Kenya, especially among young people, and its growing contribution to GDP, the Government of Kenya is keen to take up a focused enterprise development initiative in close collaboration with the private sector.

7.3.5 Local Content Programme

Over 50% of Kenyans now have access to the Internet, majority of whom access the Internet through their mobile phone. As a result, the Government embarked on develop services and products to reach these millions of Kenyans through this new media.

7.3.4.1 Tandaa Digital Content Grant

The Government ran a \$4 million three-year grant program from 2010 - 2013 through the Kenya ICT Authority to support the development of local digital content. Grantees are selected through an Annual Call for Proposals.

The Tandaa Local Digital Content Grant was a grant to provide seed funding for companies entering new media and ICT, to support Internet and mobile phone product and service delivery. Applicants were required to be Kenyan citizens over eighteen or companies/organisations registered in Kenya. Solutions could address rural or urban communities and awards can be granted from Private Sector

Innovation or Government Data Applications. Under the second round of grants, a new grant type was available for established companies and the top 150 applicants will receive free business plan training in Nairobi.

Tandaa Digital Content Grants were awarded to 14 companies and one individual under the First Round in 2010 and 21 companies (50,000 USD), 8 individuals (10,000 USD) and one matching grant (150,000 USD) under the Second Round (2011/2012).

7.3.4.2 Kenya open data initiative (KODI)

Kenya launched an open Government data portal in 2011 as the first country in sub-Saharan Africa and second on the continent after Morocco. The goal of opendata.go.ke was to make core government development, demographic, statistical and expenditure data available in a useful digital format for researchers, policymakers, ICT developers and the general public. The online portal was re-launched in July 2015, with an improved user experience and more timely and diverse data. The take up at county level has been slow. In December 2018 the website indicates that there are 686 resources across 11 sectors.

7.3.5 Information Security

In order to address cybersecurity challenges at national level, the Ministry of Information, Communication and Technology in cooperation with the ICT Authority launched the National Cybersecurity Strategy 2014 in June 2014. The Framework incorporates the National Cybersecurity Strategy, National Public Key Infrastructure (PKI) and the Kenya Computer Incidence Response Team, Coordination Center (KE-CIRT/CC).

7.3.6 Other Initiatives

7.3.6.2 ICT Hardware

ICT hardware is a very important component of ICT infrastructure and a pre-requisite to any meaningful deployment of ICT services to the population. Unfortunately, they have to be imported and until recently, imported hardware parts were not subject to any fiscal concessions. Currently, the taxes on ICT hardware are largely zero-rated. Zero-rated taxes on ICTs are integral to the Government policy objective of universal access to affordable ICT services.

The Government will set up National ICT Centres of Excellence to develop a critical mass of human resource required to support capacity for the industry.

7.3.6.3 ICT Software

The Government negotiated with various ICT software providers with a view to securing bargains that will make ICTs affordable and universally accessible. In addition to providing fiscal concessions on software, the Government also promoted local software development by encouraging a scheme to ensure that at least 50 percent of Government software procurement is sourced from local

software developers. The Government will also encourage software multinationals like *Microsoft* and *Oracle* to offer special incentives such as free development tools, training, certification and marketing support to local software developers.

7.3.6.4 eGovernment

The launch of e-Government services in Kenya is one of the main priorities of the Government of Kenya towards the realization of national development goals and objectives for Wealth and Employment Creation, as outlined in the Kenya Vision 2030. The e-Government Programme was launched in June 2004. Through the e-Citizen web portal the public has online access to a number of public services offered by various Government Ministries, Departments and Agencies, within one channel. Over time the Government has increased the number of public services that are available online. Some of these include payment of taxes through iTax, renewal of drivers' licences, business registration, passport application, and application of death and birth certificates among many more.

The portal is supplemented by Huduma Centres, which are one-stop-shop citizen service centres that provide efficient Government Services at the convenience of the citizen, from a single location.

Through the assistance of the ICT Authority all 47 counties have ICT Roadmaps that are aligned to the National ICT Masterplan and the local county development plans. This supports counties to provide the best, most cost-effective ICT-enabled services and resources to its citizens. The roadmaps have also helped county governments to make ICT investments that are consistent with global best practice and with the idea of shared ICT services with the central government and neighbouring county ICT infrastructure. The key strategies identified in the implementation of the roadmaps include Infrastructure, Connectivity and Inter-operability; Human Capital and Workforce Development; Public Service Delivery; and Policy Environment and Legal Framework.

7.4 National ICT Research Capacity and Priorities for Cooperation

7.4.1 National Priorities

To address the macroeconomic and social challenges and achieve the transformation to a knowledge-based economy, priority sectors in which ICT will be integrated to solve societal challenges have been identified.

The National Science, Technology and Innovation (STI) Sector priorities outlined in the Media Term Plan for 2013 - 2017 are:

- Nanosciences, Material science, and New Product Technologies
- Space Science
- Energy
- Biotechnology and Biosciences
- **Telecommunications, Electronics and Computers (TEC)**
- Natural products and Indigenous Knowledge

- **Science, Technology, Engineering and Mathematics Education**
- **Coordination of Technology, Innovation and Commercialisation**

National ICT Research Priorities include: Network Design, Trustworthy ICT, Intelligent Information Management, Technology-Enhanced Learning, Wireless Technology and Mobile Applications, Digital Libraries and Digital Content, Open Source Technologies, eHealth, Remote Sensing and GIS, ICT for Agriculture and eTourism.

7.4.2 National Research Capacity

The table below provides an overview of universities with ICT/Engineering Courses:

Institution	Location	Total Students	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Undergraduate Students	Post-Graduate (Masters, PhD)
University of Nairobi	Nairobi	58,188	School of Mathematics School of computing and informatics School of Engineering		45,466	12,000
Kenyatta University	Nairobi	44,778	School of Engineering & Technology	59	38,514	6,264
Moi University	Eldoret	30,694	School of engineering School of information Sciences	10	28,851	1,843
Egerton University	Nakuru	13,842	Faculty of Science Faculty of engineering and Technology		12,332	1,510
Jomo Kenyatta University of Agriculture and Technology	Juja	23,200	Civil engineering & geospatial engineering Electronic and information engineering	29	20,499	2,701
Masinde Muliro University of Science and Technology	Kakamega	8,425	Faculty of Science Faculty of Engineering		7,865	560
Maseno University	Kisumu	8,444	School of Science School of Computing and Informatics		7,166	1,278
Multimedia University of Kenya	Nairobi	1,491	Faculty of computing and IT Faculty of		1,491	0

			Engineering			
Technical University of Mombasa	Mombasa	2,419	The Faculty of Engineering and Technology		2,419	0
Technical University of Kenya	Nairobi	3,644	Faculty of engineering and built environment Faculty of applied sciences and Technology		3,644	0
Dedan Kimathi University of Technology	Nyeri	3,774	School of engineering School of Computer Science and Information Technology		3,651	123
Meru University of Science and Technology	Meru	1,359	Department of Communication and Information Technology Department of Science, Mathematics & Engineering		1,359	0
South Eastern Kenya University		1,347	School of Information and Communication Technology School of Engineering and Technology		1,289	58
Strathmore University	Nairobi	4,829	Faculty of Information Technology	12	2,273	335
United States International University	Nairobi	4,534	School of Science and Technology	10	3,809	725
Mount Kenya University	Thika	7,800	School of pure and applied sciences		7,265	535
Catholic University of East Africa	Nairobi	6,247	Faculty of Science		5,717	530
Kenya Methodist University	Meru	9,666	Faculty of Computing and Informatics Faculty of Science and Technology		8,815	851
Daystar University	Nairobi	3,747	School of Science, Engineering and Health		2,900	847
University of Eastern Africa-Baraton	Nandi	2,200	School of science and Technology		2,065	135
KCA University	Nairobi	6,400	Faculty of	21	6,200	200

			Computing and Information Management			
University of Embu	Embu	7,800	School of pure and applied science- Mathematics, computing and Information Technology	400	7,570	230
Univeristy of Eldoret	Eldoret	14,000	School of Engineering		1,3876	124

The following universities and research centres are currently involved in ICT research in Kenya

➤ **University of Nairobi**²⁴⁸

- Departments include: School of Mathematics, School of Computing and Informatics, School of Engineering, FabLab
- Research areas include: Technology-Enhanced Learning, eHealth, Mobile Telephony applications, eAgriculture, eGovernment, Cloud Computing, CyberSecurity, Interoperability
- Funding agencies include: Google, Nokia, IDRC, World Bank, University of London, Rockefeller Foundation, Ford Foundation, Centre for Disease Control (CDC), NCSTI

➤ **Strathmore University**²⁴⁹

- Departments include: Faculty of Information Technology, @iLabAfrica
- Research areas include: Mobile Computing, Technology-Enhanced Learning & mLearning, eHealth, Machine Learning and Intelligent Systems, Open Source Technologies, ICT for Sustainable and Renewable Energy, eAccessibility, Intellectual Property and Information Technology Law, Applied Research in Mathematical Sciences
- Funding agencies include Hewlett Packard, The Internet Society, Google and Safaricom
- @iLabAfrica has extensive relationships in place with industry (Safaricom, Vodafone, Ericsson, Samsung, Google, Deloitte Consulting), foundations (Clinton Health Access Initiative, IDEA Foundation) and universities (IT University of Copenhagen, MIT, Moi University, Egerton University, Mombasa Polytechnic, JKUAT and Mbabara University, Uganda).

➤ **Moi University**²⁵⁰

- Departments include: School of Engineering, School of Information Sciences
- Research areas include: Parallel Computing / Cloud Computing, Software & Services, Advanced Data Mining & Machine Learning, eHealth, Sustainable Agriculture & Environment, eGovernment, Technology-Enhanced Learning
- Cooperation Agreements include with VLIR, Belgium

²⁴⁸ <http://www.uonbi.ac.ke/>

²⁴⁹ <http://www.strathmore.edu/>

²⁵⁰ <http://www.muk.ac.ke/>

➤ **Egerton University**

- Departments include: Faculty of Science, Faculty of Engineering & Technology
- Research areas include: Parallel Computing / Cloud Computing, Technology-enhanced Learning, Dam Monitoring System, County online Databank, BPO, Video Conferencing Project
- Funding agencies include KVSA (Dam Monitoring project) and RUFORUM (eLearning project)

➤ **Kenyatta University²⁵¹**

- Departments include: School of Engineering & Technology
- Research areas include: Technology-enhanced Learning, Mobile Applications, eGovernment, Cloud Computing, Software & Services

➤ **Maseno University²⁵²**

- Departments include: School of Science, School of Computing and Informatics
- Research areas include: Parallel Computing / Cloud Computing, Software & Services, Advanced data mining and Machine Learning, Mobile Applications

➤ **Kenya Methodist University²⁵³**

- Departments include: School of Computing
- Research areas include: eHealth, Technology-enhanced Learning, Open Source Software Applications, Mobile Telephony Applications
- Recent projects include: eHealth project (June 2011 - June 2014), eLearning project (June 2010 - June 2012), Open Source Software applications project (2011 - 2013), Mobile telephony applications (June 2011 - June 2014)

➤ **KCA University²⁵⁴**

- Departments include: Faculty of Computing and Information Management
- Research areas include: System dynamics simulation modelling, software process improvements, Requirements engineering, decision support systems, mobile computing

➤ **United States International University²⁵⁵**

- Research areas include: Information Systems
- Current ICT-related projects: eMoney for enhancing MDGS at bottom of the pyramid (Funding from Institute for Money, Technology & Financial Inclusion (IMTFI), University of California, Irvine - USD15,000); eBanking, Open Source Learning Applications, Agribusiness

➤ **Jomo Kenyatta University of Agriculture and Technology²⁵⁶**

²⁵¹ <http://www.ku.ac.ke/>

²⁵² <http://www.maseno.ac.ke/>

²⁵³ <http://www.kemu.ac.ke/>

²⁵⁴ <http://www.kca.ac.ke/>

²⁵⁵ <http://www.usiu.ac.ke/>

- Departments include: Civil Engineering & Geospatial Engineering, Electronic and Information Engineering
- Research areas include: eAgriculture, Agri-food based applications, eAgriculture Farmer Voice Radio (FVR) project, Open Source Software Application, Cyber Security, Interoperability
- Funding institutions include America Institutes for Research (AIR)
- **Technical University of Mombasa (TUM)²⁵⁷**
 - Departments include: Faculty of Engineering & Technology
 - Research areas include: Mobile Applications, Parallel Computing / Cloud Computing, Software & Services
- **Technical University of Kenya (TUK)²⁵⁸**
 - Departments include: Faculty of Engineering & Built Environment, Faculty of Applied Sciences and Technology
 - Research areas include: Mobile Applications, Parallel Computing / Cloud Computing, Software & Services
- **Multimedia University of Kenya²⁵⁹**
 - Departments include: Faculty of Computing & IT, Faculty of Engineering
 - Research areas include: Communication Technologies
- **Dedan Kimathi University of Technology (DKUT)²⁶⁰**
 - Departments include: School of Engineering, School of Computer Science and Information Technology
 - Research areas include: Computing, Software and Services, Networks
- **Meru University of Science and Technology²⁶¹**
 - Departments include: Department of Communication and Information Technology; Department of Science, Mathematics & Engineering
 - Research areas include: Computing, Software and Services, Networks
- **South Eastern Kenya University**
 - Departments include: School of Information and Communication Technology; School of Engineering and Technology
 - Research areas include: Computing, Software and Services, Networks
- **Kenya Agriculture and Livestock Research Organisation (KARLO)²⁶²**

²⁵⁶ <http://www.jkuat.ac.ke/>

²⁵⁷ <http://www.tum.ac.ke/>

²⁵⁸ <http://www.tukenya.ac.ke/>

²⁵⁹ <http://www.mmu.ac.ke/>

²⁶⁰ <http://www.dkut.ac.ke/>

²⁶¹ <http://www.must.ac.ke/>

²⁶² <http://www.kari.org/>

- Research areas include: eAgriculture including Agri-food based applications; Sustainable Agriculture; Sensors & RFID to monitor livestock and wildlife; Land management; Food Security
- **Kenya Medical Research Institute**
 - Research areas include: eHealth, Open Source Software Applications
 - Projects include: East Africa Disease Surveillance Network project (EAIDSNET) funded by East Africa Community and international partners, Strengthening data management for HIV/AIDS vaccine trials project funded by Bill & Melinda Gates Foundation in partnership with Hewlett Packard

7.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and input received during IST-Africa Horizon 2020 Training Workshops in 2014 and on 10 November 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners
eHealth	Health Information Systems/Electronic medical records; Maternal, Newborn and Child Health (MNCH); Early warning systems for transmittable diseases (e.g. malaria); Integrated surveillance system;	Kenya Medical Research Institute; Strathmore University; University of Nairobi (School of Computing); Moi University; Jomo Kenyatta University of Agriculture and Technology; USIU Africa (School of Science and Technology); Kabarak University
eAgriculture	Agri-food based applications; Sustainable Agriculture; Sensors & RFID to monitor livestock and wildlife; Land management; Food Security; Disaster Risks	Jomo Kenyatta University of Agriculture and Technology; Kenya Agricultural and Livestock Research Organisation; Egerton University; USIU Africa (School of Business) ; University of Nairobi; Strathmore University; Moi University
Technology-enhanced Learning	Distance Learning; Personalised Learning; mLearning; Smart classrooms; Learning system to support disabled people & training for health professionals; Entrepreneurship	Strathmore University; USIS (School of Science and Technology); University of Nairobi (School of Computing); Technical University of Kenya (Department of Computer Science and Technology); Dedan Kimathi University of Technology
eGovernment	Public Service delivery, mGovernment	Moi University (Department of Information Technology); University of Nairobi (School of Computing); Strathmore University

7.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	<p>Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT department, Telecommunication): Smart Systems</p> <p>KCA University (Faculty of Computing and Information Management): Modelling of complex systems</p> <p>University of Nairobi (School of Computing): Technologies for IoT, Modelling of complex systems</p> <p>Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Smart Embedded Components and Systems, Smart Integrated Systems</p>
Advanced Computing	<p>University of Nairobi (School of Computing): Processor and System Architecture, Parallel Computing and Simulation Software</p> <p>Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Processor and System Architecture, Interconnect and Data Localisation Technologies</p> <p>Moi University (Department of Information Technology): Parallel Computing</p> <p>Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT Department, Telecommunication): Simulation and modelling</p> <p>KCA University (Faculty of Computing and Information Management): Simulation software</p>
Future Internet	<p>KCA University (Faculty of Computing and Information Management): Networks, cyber security</p> <p>Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Networks, Software and Services, Cloud Computing, Cyber Security</p> <p>Moi University (Department of Information Technology): Software and services, cloud Computing</p> <p>University of Nairobi (School of Computing): Software and services, cloud computing, Cyber Security, Privacy and Trust, Wireless Communication</p> <p>KENET: Networks, Future Internet, Cloud Computing</p> <p>United States International University (USIU)</p>
Content Technologies & Information	<p>Moi University (Department of Information Technology): Advanced data mining and Machine</p>

Management	<p>Learning</p> <p>Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Machine Learning; Content Access and Analytics; Big Data Technologies; Advanced Data Mining</p> <p>University of Nairobi (School of Computing) Machine Learning; Content Access and Analytics; Big Data Technologies; Advanced Data Mining</p> <p>KCA University (Faculty of Computing and Information Management): Content Technologies and Information Management</p>
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Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>University of Nairobi (School of Computing/Medical School): eHealth, improved diagnosis, healthcare provision</p> <p>Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT Department, Telecommunication): eHealth, improved diagnosis</p> <p>Strathmore University (@iLabAfrica ICT Research and Innovation Centre): health data collection, Healthcare Provision and Integrated Care</p> <p>Moi University (Department of Information Technology): eHealth, Independent and assisted living, integrated health care</p> <p>Kenya Medical Research Institute: Screening and management of diseases; Integrated health care</p> <p>USIS Africa (School of Science and Technology): eHealth models, Early warning systems</p>
Food Security, Sustainable Agriculture	<p>Moi University (Department of Information Technology): Sustainable agriculture and Environment</p> <p>University of Nairobi: Food Security, Sustainable Agriculture, Bio-Economy</p> <p>Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT Department, Telecommunication): Sustainable Agriculture and Forestry; Sustainable and Competitive Agri-food Sector for a Safe and Healthy Diet</p> <p>Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Sustainable Agriculture and Forestry; Sustainable and Competitive Agri-food Sector for a Safe and Healthy Diet.</p> <p>USIS Africa (School of Business): Agri-business and Entrepreneurship</p>

	Kenya Agricultural and Livestock Research Organisation: Agri-food based applications; Sustainable Agriculture; Food Security Egerton University
Secure, Clean and Efficient Energy	Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Energy Efficient buildings, Alternative Fuels and Mobile Energy Sources Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT Department, Telecommunication): Smart metering, Robust Decision Making University of Nairobi (School of Computing): Smart metering, Robust Decision Making. Moi University
Smart, Green and Integrated Transport	Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Socio-Economic Research and Forward Looking Activities for Policy Making Jomo Kenyatta University of Agriculture and Technology (JKUAT) - (Department of Computing, IT Department, Telecommunication): Smart Transport Equipment, Infrastructures and Services University of Nairobi (School of Computing): Smart Transport Equipment, Infrastructures and Services; Innovative Transport Management Systems
Inclusive, Innovative and Reflective Societies	Strathmore University (@iLabAfrica ICT Research and Innovation Centre): Digital Inclusion; Social Innovation Platforms, eGovernment Services, eSkills, eLearning, eCulture Moi University

Level of Research Maturity

Kenya has a vibrant research community and good track record in collaborative research with participation in **69 projects** and securing research funding of over **€ 12.3 million** under FP7. Kenya, like a number of other IST-Africa Partner Countries, is actively trying to develop a national software sector and attract Foreign Direct Investment, reinforcing the drive for innovation. The country is positioning itself as a regional hub for East Africa, which is facilitated by Nairobi's importance as an airline hub.

Up to September 2018, Kenyan organisations have secured participation in 44 Horizon 2020 projects with research funding in excess of €9.5 million across a number of thematic areas:

- ENV, H2020-SC5-2014-two-stage - **AfricanBioServices** (International Livestock Research Institute; Kenya Wildlife Service; Ministry of Environment and Mineral Resources)
- INFRA, H2020-INFRASUPP-2014-2 - **B3Africa** (International Livestock Research Institute)

- LEIT-ICT, H2020-ICT-2015 - **COMRADES** (I-Hub Limited)
- ENV, H2020-SC5-2014-two-stage - **ECOPOTENTIAL** (United Nations Environment Programme)
- TRANSPORT, H2020-MG-2014_TwoStages - **EMPOWER** (United Nations Human Settlements Programme)
- ENV, H2020-WASTE-2014-one-stage - **EWIT** (International Centre for Research In Sustainable Development Ent(ICRSD), Kisii County, Kisii University & Sellgelle International Consultancy Company Limited)
- ENV, H2020-WASTE-2014-two-stage - **REFRESH** (United Nations Environment Programme)
- Science with and for Society, H2020-GARRI-2014-1 - TRUST (Partners for Health and Development in Africa (PHDA))
- LEIT - ICT-39-2015 - **mHealth4Afrika** (Strathmore University); **its4land** (The Technical University of Kenya)
- H2020-SFS-2015-2 - **SALSA** (African Centre for Technology Studies; International Centre for Research in Agroforestry)
- H2020-WATER-2015-two-stage - **VicInAqua** (Ministry of Agriculture Livestock and Fisheries; Jomo Kenyatta University of Agriculture and Technology)
- H2020-DRS-2015 - **RESCCUE** (United Nations Human Settlements Programme)
- H2020-WATER-2015-two-stage - **FLOWERED** (University of Eldoret); DAFNE (African Collaborative Centre for Earth System Science (Access))
- H2020-SC5-2015-two-stage - **Ground Truth 2.0** (Trans-African Hydro-Meteorological Observatory; Upande Limited)
- H2020-GV-2016-RTD - **FUTURE-RADAR** (United Nations Human Settlements Programme)
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (Ministry of Education Science and Technology)
- H2020-INFRA SUPP-2016-1 - **UBORA** (Kenyatta University)
- H2020-SFS-2016-1 - **LEAP-AGRI** (Ministry of Education Science and Technology)
- H2020-INFRA SUPP-2016-1 - **SEACRIFOG** (International Livestock Research Institute)
- H2020-INFRA IA-2016-1 - **VetBioNet** (International Livestock Research Institute)
- H2020-SFS-2016-2 - **TRUE** (Kenya Forestry Research Institute)
- ERC-2014-STG - **INTERACT** (ERC-STG) - Translators Without Borders
- H2020-MSCA-RISE-2015 - **DEMOSTAF** (MSCA-RISE) - African Population & Health Research Centre Kenya
- H2020-MSCA-IF-2015 - **Tropical lichens** (MSCA-IF-GF) - National Museums of Kenya
- H2020-SFS-2016-2 - **DIVERSify** (RIA) - Kenya Forestry Research Institute

- H2020-SC5-2016-TwoStage - **H2020_Insurance** (IA) - Trans-African Hydro-Meteorological Observatory
- H2020-MSCA-RISE-2016 - **TICASS** (MSCA-RISE) - Pwani University College
- H2020-SFS-2016-2 - **InnovAfrica** (RIA) - International Livestock Research Institute; Kenya Agricultural Research Institute and Kenya National Farmer's Federation
- H2020-SFS-2016-2 - **MUSA** (RIA) - International Centre of Insect Physiology and Ecology Lbg and the Real Ipm Company (Kenya) Limited
- H2020-SFS-2016-2 - **PALE-Blu** (RIA) - International Livestock Research Institute
- H2020-MSCA-RISE-2016 - **SLAFNET** (MSCA-RISE) - Catholic University of Eastern Africa and National Museums of Kenya
- H2020-SFS-2017-1 - **AfriCultuReS** (RIA) - Locate It Limited
- H2020-MSCA-ITN-2017 - **ANTHUSIA** (MSCA-ITN-EJD) - British Institute in Eastern Africa; Kenya Medical Research Institute and University of Nairobi
- H2020-ICT-2017-1 - **EPICA** (IA) - African Virtual University and Maseno University
- H2020-ICT-2017-1 - **GO-GA** (IA) - Elimu Elearning Company Limited
- H2020-ICT-2017-1 - **ISOOKO** (IA) - Ushahidi Network
- H2020-SC5-2017-OneStageB - **TWIGA** (RIA) - Strathmore University And Trans-African Hydro-Meteorological Observatory
- H2020-EE-2017-CSA-PPI - **InvECAT** (CSA) - United Nations Environment Programme
- H2020-ICT-2017-1 - **WAZIHUB** (IA) - Strathmore University
- H2020-SFS-2017-2 - **Circular Agronomics** (RIA) - Eastern Africa Farmers' Federation Society
- H2020-SFS-2018-1 - **LEAP4FNSSA** (CSA) - Network of African Science Academies (Nasac)
- H2020-LC-SC3-2018-Joint-Actions-1 - **PRE-LEAP-RE** (CSA) - Strathmore University

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.

The research capacity of the institutions mentioned in this report was validated through a study carried out during project activities. Template profiles were circulated to most of the public and private universities and research organisations. This was followed up by email and telephone communications for clarifications. A special focus was given to universities with well established ICT/Engineering departments, postgraduate programmes and good research track record from MOEST's point of view.

7.5 Innovation Spaces

In part due to its pro-Innovation Policy and Regulatory Environment, Kenya has experienced significant growth in Innovation Spaces (private, community driven and hosted by education and research institutions) since 2009 including FabLab²⁶³ (2009) and Computing for Development Lab²⁶⁴ (C4DLab, 2013) at University of Nairobi; iHub²⁶⁵ (March 2010); @iLabAfrica (January 2011) and @iBizAfrica²⁶⁶ at University of Strathmore; m:lab East Africa (June 2011, activities now within iHub); Chandaria BIIC²⁶⁷ (July 2011) at Kenyatta University; NaiLab²⁶⁸ (August 2011); 88mph²⁶⁹/Nairobi Startup Garage (August 2011), GearBox²⁷⁰, Jomo Kenyatta University of Agriculture and Technology Center for Business Innovation - JKUAT-CBI; Regional Centre for Enterprise Development – IUPS and Enterprise Kenya²⁷¹ (2015) A small but notable actor is Pawa254²⁷², a collaborative space focused on dynamic creative industry fields. Lakehub²⁷³ is based in Kisumu, Western Kenya. These Innovation Spaces provide a mix of Pre-Incubation (iHub; @iLabAfrica; @iBizAfrica; Chandaria BIIC, Lakehub), Incubation (FabLab; C4DLab; NaiLab; GearBox; JKUAT-CBI; Regional Centre for Enterprise Development – IUPS; KIRDI) and Acceleration services (88mph/Nairobi Startup Garage; Enterprise Kenya, Pangea Accelerator) (Cunningham et al 2014). Some of these are profiled below.

University of Nairobi has hosted *FabLab* for five years (focused primarily on rapid/3D prototyping) as part the Department of Mechanical Engineering and Science and Technology Park, and the *C4DLab* since 2013 as part of the School of Computing and Informatics. Since March 2014, C3DLab is incubating 8 startups and exploring virtual incubation.

Hosted by the IT Faculty, **Strathmore University**, *@iLabAfrica* was established in January 2011 as a Centre of Excellence in ICT Innovation, Entrepreneurship & Incubation, and Policy Research for Africa. It expanded onto a second floor of dedicated space in June 2014. *@iLabAfrica* has successfully built industry research partnerships and launched a Master's programme (MSc. MTI) in Mobile Telecommunications and Innovation. *@iBizAfrica* was set up in January 2012 as an Incubation Programme.

Kenyatta University (KU) launched the *Chandaria BIIC* in July 2011. BIIC aims to support up to 100 innovators per year (including 30% non-KU students), blending research with entrepreneurship training. It aims to blend applied research with innovation and establishment of start-ups as well as

²⁶³ <http://fablab.uonbi.ac.ke>

²⁶⁴ <http://www.c4dlab.ac.ke>

²⁶⁵ <http://www.ihub.co.ke>

²⁶⁶ <http://www.ibizafrica.co.ke>

²⁶⁷ <http://www.ku.ac.ke/chandaria-biic/>

²⁶⁸ <http://www.nailab.co.ke>

²⁶⁹ <http://www.88mph.ac/nairobi>

²⁷⁰ <http://gearbox.co.ke/>

²⁷¹ <http://innovation.icta.go.ke/enterprise-kenya/>

²⁷² <http://www.pawa254.org>

²⁷³ <http://lakehub.co.ke/>

predispose Kenyatta University students and Kenyans in general towards being job creators rather than job seekers. Their strategy is to sensitize students and the population at large to the importance of job creation. 40 ideas had been nurtured by February 2013. A new building inside the KU Campus has been completed. Partners include Chadaria Foundation, NACOSTI, Youth Enterprise Development Fund and Orange Kenya and others.

Jomo Kenyatta University of Agriculture and Technology²⁷⁴ (JKUAT is supporting “uptake of research results by industry” by implementing the **Nairobi Industrial and Technology Park** in partnership with **Ministry of Industrialization**.

iHub launched in March 2010 as a Tech pre-Incubation and Collaborative Working Space, has three types of membership: White (Virtual – limited physical access); Green (free shared space for up to twelve months for 150 – 200 individuals) and Red (paid dedicated space for 12 months) members registered. Regular community events are hosted to encourage sharing of experiences. Over 50 companies have been established since its launch. iHub activities include iHub Research (March 2011), m:lab (June 2011), Pivot25/Pivot East (mobile app competition), UX Lab and Supercomputing Cluster (2012).

m:lab East Africa was launched in June 2011 as a mobile technology incubation centre by a consortium (eMobilis, World Wide Web Foundation, School of Computing and Informatics - University of Nairobi, iHub), with \$725,000 seed funding from InfoDev (www.infodev.org). Services include business incubation, training, research and application testing. Up to June 2014 [24] m:lab supported over 60 startups through its four-month Mobile Application Development and Entrepreneurship Programme and office space for up to 24 months to five past and five current incubatees and Savannah Fund. m:lab supporters include Nokia, Samsung, Microsoft and SEACOM. m:lab was an implementing partner in InfoDev two year East Africa Virtual Incubation pilot (\$180,000 funding from UKAid) running in Kenya, Rwanda, Tanzania and Uganda. The activities from m:lab were taken over by iHub after the project funding.

NaiLab is a Business Incubator supporting entrepreneurial teams with mobile/web space innovations. Launched in August 2011 with support from Accenture and 1% Club, it provides collaborative working space, Internet access and mentoring. NaiLab takes a 3% - 10% equity stake in return for incubation of three to twelve months. Nine start-ups have been incubated to date, with five more currently being incubated. NaiLab was awarded the \$1.6 million Kenya ICT Incubation Program contract in January 2013 under which it was contracted to incubate 30 startups by 2016 and was an implementing partner in the InfoDev East Africa Virtual Incubation pilot.

88 mph rebranded its Kenyan accelerator as Nairobi Startup Garage in June 2014. Offering seed capital (\$1.7 million invested in 19 startups) and accelerator programmes targeting mobile and web start-ups, 88mph was launched by Danish investors in August 2011. Start up Garage co-working

²⁷⁴ <http://www.jkuat.ac.ke>

space was launched in February 2012 by 88mph and Human IPO. To date 88mph / IPO48 has invested in 10 start-ups and started 5 companies. 88mph takes 15% - 35% equity stake for investment of up to \$24,000. In August 2012, 88mph partnered with Google to provide extended support to local start-ups.

Kenya Industrial Research and Development Institute (KIRDI) is a national research institute established in 1979 under the Ministry of Trade and Industry and mandated to undertake multidisciplinary research and development in industrial and allied technologies. The KIRDI ICT Incubation program is focused on supporting an entrepreneurial culture to support the creation of enterprise start-ups; micro, small and medium-sized enterprise (MSME) and mentorship.

Enterprise Kenya²⁷⁵ is an initiative under the ICT Authority to develop a national accelerator which can provide mentorship, create ICT centres of excellence and establish an Equity fund to support ICT innovations. It was initiated in 2015 to contribute to the National ICT Masterplan 2017 and is yet to be formally commenced.

The **Pangea Accelerator**²⁷⁶ has just closed a call for the Kenya Shelter Tech Accelerator, which is a collaboration between Pangea, BDO and Habitat for Humanity. This is a six month program with tailored support and the opportunity to secure \$50k of equity funding.

ygap²⁷⁷ is an Australian based not-for-profit focused on supporting impact entrepreneurs to implement local solutions to local problems. ygap Kenya supports startups by providing a one week live-in accelerator focused on strengthening business models and provide necessary tools to achieve viability. Supported start-ups can access grant of investment funding of AUD\$10 - \$50k. ygap also have a dedicated program for female led early stage startups – yher Africa.

IBM set up a **ThinkLab**²⁷⁸ in Nairobi to undertake basic and applied research focused on addressing African challenges. The Lab allows clients and partners from across Middle East and Africa region to gain hands-on experience of IBM's latest cognitive, cloud, big data analytics and mobile technologies Fitted with some of the most advanced interactive technologies, THINKLab provides IBM's Africa based researchers with a stimulating environment to demonstrate the latest solutions in keys areas such as education, healthcare, water management, public safety and financial inclusion. The facility also facilitates IBM's scientists' engagement with the community representatives – inviting them to be part of the research and development process.

²⁷⁵ <http://icta.go.ke/enterprise-kenya/>

²⁷⁶ <https://www.pangeaa.com/>

²⁷⁷ <https://ygap.org>

²⁷⁸ <http://www.research.ibm.com/labs/africa/>

8. KINGDOM OF LESOTHO

8.1 Introduction

The Kingdom of Lesotho is located in Southern Africa, an enclave of South Africa. Lesotho has an area of 30,355 km, with 10 administrative divisions (Berea, Butha-Buthe, Leribe, Mafeteng, Maseru, Mohale's Hoek, Mokhotlong, Qacha's Nek, Quthing, Thaba-Tseka). The population as at July 2018 was estimated to be 1.962 million with a literacy rate of 79.4%. Sixty-two percent of the population is between 15 and 64 years of age (median 23 years). Maseru, the capital city, has a population of 202,000 (2018 CIA World Factbook). The official languages are Sesotho and English.



Key sectors in Lesotho are agriculture, followed by industry and services. Lesotho produces about 90% of its own electrical power needs. Economic growth is dependant on manufacturing, diamond mining and services. Export partners include US, Belgium and Canada.

Lesotho has developed a good policy framework. The ICT Policy was approved and adopted as a working document in March 2005. The main driver of the ICT policy is the Ministry of Communications, Science and Technology. The Universal Access Fund was established in 2009. The Science Technology and Innovation Policy was reviewed in 2010 and proposed that an Innovation Fund be established to support research and capacity development. The Communications Act 2012 became operational in April 2012. The Electronic and Transaction Bill and the Lesotho National Broadband Policy were drafted in 2014, and the Computer Crime and Cybercrime Bill was drafted in 2015 (to be revised). Both are awaiting being passed into Bills by Parliament. The National Strategic Development Plan (NSDP, 2013 -2017) highlights that the main goal of the communications sector is to facilitate access to high-speed broadband and to basic ICT services throughout the country and widen ICT literacy.

In relation to Communications, according to the Lesotho Communications Authority (LCA)²⁷⁹ there were 2.23 million telephone mobile subscribers with a teledensity rate of 119% as at March 2017. Fixed services continued to decline and by the end of March 2017, subscribers for fixed voice services had fallen to 28,206 from 41,123 in the corresponding period in 2016. Internet subscribers increased to 923,407 in March 2017 compared with 833,532 in March 2016. Mobile broadband subscriptions increased from 831,194 in March 2016 to 917,771 in March 2017. While fixed Broadband subscriptions increased from 2,062 in March 2016 to 5,636 in March 2017, it is still less than 1%. 49% of the population is using the Internet. A survey of Internet cafes is undertaken on a

²⁷⁹ LCA Annual Report 2016-17, published June 2017

biannual basis. As at September 2016 there were 43 Internet cafes, representing a decrease of 14% over a six month period. Challenges identified included adoption of smart phone, increasing mobile broadband penetration and increased number of Wi-Fi hot spots.

LCA undertook a broadband study, which determined that mobile network coverage in Lesothos is at 96%. Mobile prices are higher than the average in the SADC region. while data prices are in the mid range of other African countries. However the costs associated with devices and data services are creating barriers to service take up.

In September 2018 Vodacom Lesotho launched a 5G network on 3.5 GHz spectrum. The Central Bank of Lesotho and Lets'eng Diamonds are using it initially. Vodacom aims to make 5G available to customers as 5G compliant devices become more accessible to the general public.

Challenges in relation to Internet bandwidth costs and connectivity are gradually being eradicated by developments such as the arrival of the East and Southern African Optic Submarine Cable System (EASSy) and the increasing adoption of converged technologies such as Wireless Local Area Networks (WLAN), Code Division Multiple Access (CDMA) Worldwide Interoperability for Microwave Access (WiMAX) and Third Generation (3G) High-Speed Downlink Packet Access (HSDPA). The introduction of 4G Long Term Evolution (LTE) services will support high-speed mobile broadband Internet access. Lesotho currently has two mobile telecoms providers – Econet Telecom Lesotho and Vodacom Lesotho, which both provide a similar level of 2G and 3G voice coverage.

In terms of ICT Infrastructure, Lesotho is a participant in EASSy, through a Special Purpose Vehicle (SPV) and the West Indian Ocean Cable Company (WIOCC). The cable went live in July 2010 and provides direct access to high-speed bandwidth for broadband services. The introduction of the WASACE cable also provides more options. As a result of these developments, internet bandwidth prices are going down and mobile data services are being more affordable. LCA is responsible for administrating Internet domain names and supporting the establishment of Internet-related infrastructure in Lesotho.

As part of the Universal Service Fund, the Lesotho Communications Authority (LCA) supported the establishment of the Internet Exchange Point in Lesotho (LIXP), which facilitates all internal Internet traffic to be handled within Lesotho. The LIXP project has helped address the issue of connectivity with the international bandwidth challenges. To help in this respect, LCA has a partnership with Afrinic. The data centre hosts the LIXP facilities and the infrastructure for the management of the country Top-level domain (.ls). The Universal Service Fund provided subsidies of M14.6 million during the 2016/2017 financial year to support twelve mobile network expansions projects. Co-funding from African Development Bank (M16.2 million) was provided towards six of these network expansion projects. A further M6.8 million was invested in broadband development.

In terms of national back bone and accessibility around the country Lesotho has mostly copper cables and fibre optic cables to a certain extend and satellites where there are no cables.

There are one public university (National University of Lesotho), Lerotholi Polytechnic, Lesotho College of Education, National Health Training Centre and a private university (Limkokwing University of Creative Technology).

8.2 ICT Background

The National Strategic Development Plan (2013 - 2017) aims to support the development of an ICT-based Information Society. Its main goals in relation to ICT are to improve the ecosystem and backbone infrastructure (require facilitation of access to high speed broad band and access to basic ICT services throughout the country), to reach universal access and widen ICT literacy, review the e-government strategy and plan to facilitate implementation, facilitate smooth migration from analogue to digital, promote the growth of e-services, and develop niche ICT sub-industries through Foreign Direct Investment (FDI), research and development and enhance surveillance capacity to deal with cyber security.

The ICT Policy, which was adopted in 2005, also has objectives that strongly support infrastructural development including: Universally accessible advanced communications networks, provide and sustain diffusion of ICT infrastructure for access to ICT services and products, encourage infrastructure sharing among network operators to optimize scarce resources, create a favourable investment environment for the private sector in the development of ICT infrastructures and endorse competition in the ICT sector so as to increase customer choice, quality and affordability of services.

Lesotho's ICT Policy identifies nine critical areas for the development of the country, namely;

- ICT and supporting infrastructure
- Education and human resource development
- Enabling legal and regulatory framework
- Rapid delivery of ICT services to society
- eGovernment
- eCommerce
- Health
- Agriculture and Food Security
- Tourism, Environment and Natural Resources
- Gender and Youth

The proposed regulatory framework encourages the deployment of converged technologies, which can be offered over existing networks using IP technology. The country adopted a technology neutral approach in selecting appropriate, scalable technology needed to build robust communications networks. Secondly, the policy seeks to encourage the expansion of the national electricity grid in order to support the deployment of ICT infrastructure. The Electronic and

Transaction Bill was drafted in 2014 and the Computer Crime and Cybercrime Bill drafted in 2015 (to be revised).

The Universal Access Strategy was developed in 2001 to support access to a range of services (telephony, Internet, radio, television, postal services) across the country. In 2009, the Universal Service Fund (USF) was established to provide access and connectivity to communications services in unserved and underserved areas. It provides subsidies to support mobile expansion projects to extend mobile network coverage to unserved areas and to support broadband development. The Fund also embarked on a Wireless Network Broadband project to provide broadband internet access to communities, 44 schools and 29 health institutions in partnership with the International Telecommunication Union (ITU). It supported the operations of the Lesotho Internet Exchange Point (LIXP). The virtual landing point that brings additional international Internet bandwidth into the country through WIOCC is operational. The company that runs the country-code Top Level Domain. USF and LSA CSI are supporting programs in high schools providing equipment, infrastructure, connectivity and digital skills training. The enhanced infrastructure puts Lesotho in a position to benefit from the use of information and communication technologies to further economic development.

The Parliament passed the new Communications Act 2012 and it came into operation at the end of April 2012. It is aimed at consolidating all pieces of primary legislation that preceded it and would enable Lesotho to truly participate in the global information society. The Communication Act (2012) provides for:

- The establishment of the Universal Service Fund and thus addressing more areas of communications other than just access;
- The introduction of co-regulation and self-regulation within the broadcasting industry through the establishment of the Broadcasting Dispute Resolution Panel (BDRP);
- The introduction of competition management in the communications services markets. Better regulation of market competition, interconnection agreements and anti-competitive practices would ensure efficiencies and would result in higher quality services as well as lower communication costs, and;
- The introduction of regulation of Postal Services by LCA. When regulated, postal services would develop faster than at the present moment.

The Radio Frequency Spectrum Management Policy of 2014 replaces the Radio Frequency Spectrum Policy of 2008. The LCA Board has extended the use of Industrial, Scientific and Medical (ISM) frequencies beyond wireless Local Area Networks (LANs) and hotspots to incorporate wireless mesh networks. The Lesotho National Broadband Policy was drafted in 2014.

Many ICT projects were launched in the public and private sector including the Lesotho Government Data Network (LGDN), IEC (2012 elections registration confirmation & results on Website,

‘campaigns’ on Social networks), World Vision (including Area Development Programs – emergency relief), Lesotho Meteorological Services (Climate Action Intelligence, involves High Performance Computer) and others (Postal, Traffic, Passports, Security).

8.3 Current ICT Initiatives and projects

The following section provides an overview of current ICT initiatives ongoing in Lesotho in the areas of eLearning, eHealth and eGovernment. Previous eLearning projects included NEPAD eSchools Demo project, SchoolNet Lesotho, Laptops to Lesotho Project and Pan African eNetwork for Tele-education. . Previous eHealth projects included the ICT Village in Mahobong, Social Welfare Routine Information System, supporting training for District Health Management System 2 DHIS2), Pan African eNetwork for Tele-Medicine, Laboratory Information System and Rx Solution information management project.

8.3.1 eLearning / Technology-Enhanced Learning

The National ICT Policy supports the uptake of higher levels of ICT access and usage in its communities and education institutions. There are also some private sector companies independently engaged in making some technology accessible to schools at a price on the basis of leasing PCs to schools. Previous initiatives include Pan African eNetwork for Tele-education and Lesotho School Technology Innovation Centre (STIC). A study undertaken by the National University of Lesotho recommended the use of a Virtual Laboratory in Lesotho High Schools. Pilot projects have commenced with support under the Universal Service Fund and LCA CSI. Current education related projects include: Programs for Schools, NUL Collaboration and learning Environment for Higher Education; Africa Code Week; and Training through Learning Hub Lesotho. It is envisaged that in the future after the equipment provided under the Pan-Africa eNetwork is transferred from the Indian Government to the African Union Commission, this project may commence again with participating Member States making a contribution towards costs.

8.3.1.1 Programs for Schools

Lesotho Communications Authority (LCA) is supporting programs for Schools under the Universal Service fund, in collaboration with the Ministry of Education and Training, as well as providing additional resources under Corporate Social Investment (CSI).

Under the Universal Service Fund 12 pilot High Schools were provided with eLearning facilities including a mobile computer lab with 24 laptops allocated for students, a server, projector, projector screen and digital skills training. Thirty schools received broadband connectivity during 2016 / 2017 financial year. It is envisaged that the pilot will run for five years. To date it has been identified that further digital literacy training is required and schools require more ICT infrastructure.

Under CSI LCA provided a further 48 laptops for students, software licenses, projector and projector screens, internet connectivity and digital literacy training for teachers in two schools during the 2016/2017 financial year.

Funding sources: Universal Service Fund

Geographic scope and time frame: National; ongoing

8.3.1.2 Vodacom Mpesa Schools Competition

Vodacom has an annual competition for schools whereby schools encourage parents to pay school fees with M-Pesa. The school with high proportions of fees paid through M-Pesa stands a chance to win a fully equipped Computer Lab. Over the past three years, three schools have won a fully equipped Computer Lab.

Funding sources: Vodacom Lesotho

Geographic scope and time frame: National; ongoing

8.3.1.3 National University of Lesotho Collaboration and learning environment (CLE) for Higher education. (2014 - Present)

The National University of Lesotho customised a Collaborative Learning Environment (Thuto) to improve teaching and learning at the higher education institution by providing an interactive platform for teaching and learning. It also provides an intranet enabling different NUL offices to share files and communicate online from anywhere at anytime. It was integrated with the existing internal information systems to enable seamless exchange of information such as the students' registration information and relevant University staff details.

It has supported reductions in communication and information sharing costs dramatically, by eliminating the need to print physical documents as a way of realizing internal communication. It supports efficient and timely communication within the National University of Lesotho and an improved teaching and learning environment through online access to learning materials and resources.

Funding sources: University of Lesotho

Geographical scope and time frame: National; ongoing

8.3.1.4 Africa Code Week (Teaching programming to young learners)

Founded in 2015 and spearheaded by SAP, Africa Code Week is a continent-wide initiative to simplify software coding for Africa's youth. The mission is to empower future generations with the coding tools and skills they need to thrive in the 21st century workforce and become key actors of Africa's economic development.

The LesothoAfrica Code Week is supported by UNESCO Science and Mathematics Education Federation (SMEF), the Lesotho National Commission for UNESCO, in partnership with Girls Coding Academy, GEM Institute and the National Department of Science and Technology in Lesotho. Google International provides grants for training young learners and trainers countrywide. The winning schools receive certificates and tablets.

Funding Sources: The Lesotho Commission for UNESCO, Google

Geographic scope and timeframe: National; ongoing

8.3.1.5 Learning Hub Lesotho

Higher Life Foundation Lesotho (an initiative under Econet Telecom Lesotho) launched a Learning Hub in Maseru in May 2014 to support MDG2 Universal primary education for all by 2015. The offices in Maseru are close to four primary schools and 5 secondary schools (c2,700 students in total). The hub has 15 desk top computers with connections to the Internet and a reading section with educational and social materials. The hub is available to students and teachers from 9am to 5pm each day free of charge to undertake research and improve their digital skills.

Funding: Econet Telecom Lesotho, Higher Life Foundation Lesotho

Geographical scope and time frame: National; ongoing

8.3.2 eHealth

Current eHealth projects include: the Moyo Lesotho project and the EMR project. Previous projects include the Pan African eNetwork for Tele-medicine and training to support use of DHIS2.

8.3.2.1 The Moyo Lesotho Project

The Moyo Lesotho Project was launched in 2016 by the Minister of Health using Vodacom's mobile technology to provide children and pregnant women with HIV treatment and transportation to health facilities. This multimillion dollar effort was led by the Lesotho Ministry of Health, Vodafone Foundation, Vodacom Lesotho Foundation, USAID and international private donors.

The project captured patient health data at the point of contact through a mobile app created by the Vodacom Foundation. The data was then automatically aggregated and uploaded onto a database, which allows for real-time fine-tuning of the programme to better provide for the patients. The aim was to double the number of HIV positive children on treatment in three years and to eliminate mother to child transmission of HIV.

A practical challenge that the programme aimed to address was the cost of travel to clinics for treatment. Vodacom incorporated their M-Pesa mobile money system into patient referral processes so that money could be transferred to assist patients who need to travel to a health centre. M-Pesa allowed for immediate transfers of funds to the women and children in need of getting to the clinic for further follow up and lab tests. To further improve access to HIV care and treatment, the Government of Lesotho had made medication and healthcare around HIV free of charge in Lesotho.

Funding source: Vodacom Foundation, USAID, International donors

Geographic scope: National

8.3.2.2 Open Electronic Medical Records (EMR) System

The Ministry of Health in cooperation with ICAP is developing an in-house solution for an EMR system, which is aimed at reducing manual patient registration, consultations, admissions, dispatch etc., making the entire process digital.

The EMR system is currently in a preliminary state to facilitate tested for patient registration. Other modules will be integrated later. The EMR system will feed information into the DHIS2 system and connect to a data center at the Ministry.

Funding source: ICAP

Geographic scope and time frame: National and ongoing

8.3.2.3 NUL Early Detection of Cancer System

The NUL Computer Science unit is pursuing a system to facilitate in early detection of cancer. The system will accept CT scans and X-ray images as input to be processed. The system will process the images to detect cancerous cells and provide an analysis based on image processing. The project is part of the projects being incubated by the NUL Innovation Hub.

Funding source: NUL Innovation Hub

8.3.4 eGovernment

Current eGovernment projects include: Lesotho Government Data network, Broadband Policy project, Broadband Wireless Network Project, Cyber Security project, eGovernment Infrastructure project, upgrading the IFMIS system, implementation of the eTransport system. Previous projects include the Utilities Sector Reform project, Digital Broadcasting Migration project

8.3.4.1 Upgrade of Integrated Financial Management System (IFMIS)

This project aims to computerise the budget management and accounting system for government by providing an integrated computerised financial package. The longer term aim is to increase the effectiveness and transparency of public resource management.

Funding source: World Bank

Geographic scope and timeframe: National and ongoing.

8.3.4.2 Implementation of eTransport System

This project aims to expand road traffic services across Lesotho and be available on demand online.

Funding source: World Bank

Geographic scope and timeframe: National and ongoing.

8.3.4.3 Lesotho Government Data Network (LGND)

This project was an expansion of the Lesotho Government Data Network to district capitals. LGDN aims to connect all government offices in Maseru and in the other nine (9) districts to one network and data centre housed at Moposo House, the Ministry's headquarters. This will help to significantly reduce communications and data-sharing costs within government. A further project commenced in 2014 to resources for the LGDN project.

The main objectives were to:

- Ensure a connected government and support for rolling out IFMIS and related applications at the district level.
- Provide a reliable and secure backbone infrastructure that will cater for current and future IT needs of the government
- Eliminate duplication, facilitate interoperability of systems and reduce cost by sharing common network components across systems
- Create a stable communications platform for all ministries/departments to utilize in the execution of their citizen-centric operations
- Strengthen collaboration between various tiers of government
- Improved government service delivery to its citizens regardless of location by having access to similar services and applications throughout the Kingdom

All ten districts have been interconnected, with more than 110 sites connected and all links with 4MBPS.

Source of funding: Lesotho Government

Geographic scope and timeframe: National and ongoing

8.3.4.4 Broadband Policy Project

This project, which was coordinated by the Department of ICT, aims to formulate a Broadband policy that will enable more accessibility/penetration. The project started in 2014. The second draft of the policy was completed and is to be presented to the Cabinet for approval

Source of funding: ITU and Lesotho Government

Geographic scope and timeframe: Nation wide; ongoing (5 year period)

8.3.4.5 Broadband Wireless Network Project

This project focuses on:

1. Deployment of wireless broadband infrastructure for identified areas in Lesotho.
2. Development of ICT applications for Lesotho.
3. Training local experts on the operation of deployed wireless communication networks.
4. Development of national ICT broadband network plans for the entire territory of Lesotho that will

deliver free or low cost digital access for schools and hospitals, and for underserved populations in rural and remote areas.

5. Development of an impact assessment report.

Funding: ITU

Geographic scope and timeframe: National and ongoing

8.3.4.6 Cyber Security Project

The Lesotho Communications Authority leads this project. It project aims to develop and promote harmonized policies and regulatory guidelines for the ICT market as well as build human and institutional capacity in the field of ICT through a range of targeted training, education and knowledge sharing measures. Through this project, three national experts were recruited to work with three international experts to facilitate two workshops in Maseru whose aim was to transpose three SADC model laws into Lesotho laws.

The model laws are:

- a) Data Protection;
- b) Electronic Commerce and Electronic Transactions, and
- c) Computer and Cyber Crime

The workshops focused on building capacity and empowering stakeholders so that they could contribute to the adaptation of the model laws. Based on the questionnaire which was completed during the first workshop, the ITU experts were able to understand the need and context of Lesotho concerning issues that the model laws are focused on addressing. The second workshop incorporated work that was done by the expert teams to transpose model laws into the Lesotho laws. The ITU also provided an expert mission to Lesotho to assess her readiness to establish a national Computer Incident Response Team (CIRT). The mission consulted and interviewed key stakeholders and also conducted multiple studies and research to gather facts regarding the readiness of the country to establish a national CIRT.

This project has been extended to 2018 to facilitate a national CIRT to be put in place.

Funding: ITU through HIPSSA project “Support for Harmonization of ICT Policies in Sub-Saharan Africa”

Geographical scope and time frame: National and ongoing until 2018

8.3.4.9 eGovernment Infrastructure Project

The African Development Bank supports the project. It aims to enhance good governance through the deployment of an e-government broadband infrastructure. The project aims to enhance coordination of public service delivery across Ministries, key agencies and local governments. The project also aims to strengthen existing Government data centers and portals to provide online services, improve bandwidth access to submarine cables for e-services and extend coverage to

under-served areas for state building such as automated administrative services including e-payroll; civil registration; e-health, e-procurement, e-customs; and, revenue management

The project is composed of four components:

1. Core Network Infrastructure: Upgrade of core optic network and broadband access: optimise the metropolitan core fibre and addition of core fibre from the two datacentres in Maseru to Mochale's Hoek. This will be achieved through undertaking IRU-service contract of laying OPGW on the Lesotho Electricity Company (LEC) power lines. In the case of broadband access, 4 unserved areas have already been selected and the construction of BTS will be assisted through 2% funded from the Universal Service Fund.
2. Strengthening data centres: Upgrading equipment and improving control in the data: data center in Mochale's Hoek has been updated to a tiers 3 standards. It will be operational before the end of 2018. In order to control entrance, CCTVs and biometrics security have been installed. Additionally physical control by the Lesotho Defence force has been put in place..
3. Government ePortal: Architect and design the eGovernment portal: The website has been developed, to go live by end of October 2018. As an eServices pilot, the portal will start with 20 online services. The project, in collaboration with the Local Government, has constructed service centres in two unserved areas. Tenders for construction of five service centres are already in the public domain. The procurement for call centre equipment is on the pipeline.
4. Skills Development: Facilities for training and research: Three laboratories have been refurbished at the Lerotoli Polytechnic where there will be training of students on ICT certification and some of ICT professionals would be duly assisted on the capacity building programs. There is also a conferencing facility intended for meetings, workshops and networking contacts in Africa.

Funding: African Development Bank and Universal Service Fund

Geographic scope and timeframe: National; started in 2014, ongoing

8.3.5 eServices

Current eServices projects include: Online Service Provider Directory and eTransactions (bank to wallet services).

8.3.5.1 Online Service Provider Directory

The United Nations Children's Fund (UNICEF) in partnership with the European Union have partnered with the Ministry of Local Government and Chieftainship to pilot the Citizen Service Centre concept. The main objective is to expand the range of services available to citizens at local level to address the multidimensional character of poverty and vulnerability. Investigations, recommendations and implementation of ICT solutions that could improve service awareness about available services across different communities in Lesotho especially the rural areas were conducted. After performing an investigative study and assessment of the rural community councils,

a recommendation was that an online service provider directory could solve the problem whilst incurring the least costs.

The objectives of the online service provider directory include:

- To increase knowledge of services offered in each community council
- To increase referrals to various service access points for citizens
- To increase cooperation between service providers at community levels
- To link with other initiatives that government already has in place, particularly the e-Government project.

The online service provider directory consists of a database and a web interface. The database stores information about service providers, service procedures and communication materials. The web interface serves as the platform on which users access the system. Besides directory development, training materials and manuals will be produced. The Ministry of Local Government and Chieftainship, and Ministry of Communication Science and Technology IT staff will maintain and support the directory.

Funding: United Nations Children's Fund and EU

Geographic scope and timeframe: National; ongoing

8.3.5.2 eTransactions

Econet Telecom Lesotho in partnership with Standard Lesotho Bank introduced a 'Bank to Wallet' service on Standard Lesotho Bank's Mobile Banking platform. It is a one-stop-shop, which allows all Standard Lesotho Bank account holders to transfer money into their own EcoCash wallet or family and friend's wallets using the Mobile Banking service. It also offers them the best value for money. The service is the first of its kind in Lesotho.

Funding: Econet Telecom Lesotho

Geographic scope and timeframe: National; ongoing

8.3.6 eAgriculture

The National University of Lesotho is performing research and development of a decision support system that provides smallholder farmers with field level recommendations based on farm-level agronomic data. The aims of this research include:

- Develop low cost soil health test kits that can be used by small-holder farmers.
- Develop a data-driven analytics system to collect, merge and analyze field-level data and make recommendations on agronomic practices
- Develop a system for dissemination of information to farmers, stakeholders and policy makers.

NUL anticipates to work with colleagues from Faculty of Agriculture - Soil science on this project. The output of this research will benefit smallholder farmers in Lesotho.

8.4 National ICT Research Capacity and Priorities for Cooperation

8.4.1 National Priorities

The Government of Lesotho through the Ministry of Communications, Science and Technology in conjunction with relevant stakeholders in the ICT sector has identified the following priority e-applications: e-Government; eHealth; eLearning; e-Commerce; eInfrastructure; Digital Content and Digital Libraries; eAgriculture & Geographic Information Systems; and Internet Technologies.

In line with its National Science and Technology Policy, Lesotho sees the role of research and development as a major activity that defines the critical agenda in the national system of innovation and in the industrial and commercial transformation. R&D is critical in the production of new knowledge, new materials, publications and new services. It is a critical tool towards promotion and development of ICT in the Information Society by identifying needs and challenges that face the ICT sector thus informing policies, programmes and projects.

In this context the following research priorities have been identified for Lesotho:

Research Priority: ICT for Government and e-Government

Research Objectives	Research Areas
Facilitate the broadest possible access to public domain information (2.1.4)	<ul style="list-style-type: none"> Speech Recognition and Text-to-Speech for information access. Access Networks using available e-infrastructure such as GSM and PSTN networks. Web applications using indigenous languages. Free/libre and open source software (FLOSS) utilization for e-government solutions.
Promote the production of local ICT products and services that reflect the needs, interests and culture of the country. (cf. 2.2.4)	<ul style="list-style-type: none"> Web applications and information systems for marketing and advertising the government tourist attractions
Establish ICT public access points in places such as post offices, schools, libraries and rural health care clinics among others. (2.2.6)	<ul style="list-style-type: none"> Developing mesh networks for rural areas Convergence of analogue and data networks
Paying attention to the special needs of	<ul style="list-style-type: none"> Speech recognition and text-to-speech for

marginalized groups of society, including women, youth, the disabled, disenfranchised and the elderly. (2.2.6)	<p>the visually impaired and the elderly for government services access.</p> <ul style="list-style-type: none"> ▪ Development of training methodologies for people with special needs and the marginalized. ▪ Development of electronic and mechanical devices for the people with disabilities.
Ensure that ICT infrastructure is widely available at an affordable price to support the delivery of telecommunications, broadcasting, postal and multimedia services (2.2.7)	<ul style="list-style-type: none"> ▪ Software development cost reduction through use of FLOSS
Improve internet access for tourists throughout the country	<ul style="list-style-type: none"> ▪ Appropriate access points developed throughout the country for tourists to have internet access with the aim of attracting more tourists into Lesotho

Research Priority: ICT for Health & e-Health

Research Objectives	Research Areas
Ensuring that all local clinics and hospitals are connected to the ICT infrastructure (2.2.7)	<ul style="list-style-type: none"> ▪ Convergence technology development for interconnecting the PSTN, GSM and Radio broadcast communication systems. ▪ Developing web services and access channels for remote patient diagnosis ▪ Visibility studies on low cost ICT infrastructure in the mountainous areas of Lesotho.
Online HIV/AIDS information access for rural communities	<ul style="list-style-type: none"> ▪ Web services for HIV/AIDS information in Sesotho ▪ Development of HIV/AIDS interactive information stations at local government offices using FLOSS
Online/Mobile Access to medical practitioners and institutions	<ul style="list-style-type: none"> ▪ Development of mobile- and e-commerce applications for service access

Research Priority: ICT for Learning & e-Learning

Research Objectives	Research Areas
One lecturer – multiple classrooms throughout the country (IEMS can benefit from this objective)	<ul style="list-style-type: none"> ▪ Optimization of Communication networks for enabling distance e-learning
Use of mobile devices for teaching	<ul style="list-style-type: none"> ▪ Software development for mobile devices ▪ Cost effective methodologies of implementation

Research Priority: ICT for Enterprises & e-Commerce

Research Objectives	Research Areas
Private sector service access using both the internet and mobile devices (e.g. banking)	<ul style="list-style-type: none"> ▪ Development of interactive web services and WAP services
Online payments for electricity, water and gas	<ul style="list-style-type: none"> ▪ Development of interactive web services and WAP services
Promote the development and dissemination of local ICT products and services (2.1.5)	<ul style="list-style-type: none"> ▪ Qualitative and quantitative studies for assessing the research efforts and innovation in the ICT sector throughout the country. ▪ Marketing strategies for local ICT products and innovations
Online shopping (e.g. ordering pizza)	<ul style="list-style-type: none"> ▪ Development of Mobile Commerce Applications

Research Priority: Network Technologies

Research Objectives	Research Areas
Develop network technologies suitable for government service delivery in Lesotho	<ul style="list-style-type: none"> ▪ Study of existing infrastructure and development of network protocols suitable for ensuring access to government information. ▪ Mesh network development for rural areas ▪ Wireless networks (WiMAX) capabilities for enhancing the ICT infrastructure in Lesotho.

Improvement of bandwidth for local information and services access	<ul style="list-style-type: none"> Study of data and voice traffic and the quality of service required for such traffic in order to effectively manage the bandwidth
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8.4.2 National Research Capacity

The table below provides an overview of universities with ICT/Engineering Courses:

Institution	Location	Total Students	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Undergraduate Students
National University of Lesotho	Roma, Maseru	1,357	Faculty of Science and Technology	12	266
Letotholi Polytechnic	Maseru	185	Dept of Engineering	7	185
Lesotho College of Education	Maseru		Dept of Information Technology, Dept of Computer Science		
Limkokwing University of Creative Technology	Maseru	462	Dept of Computer Technology	25	462

The following national organisations are currently undertaking ICT-related activities in Lesotho:

➤ National University of Lesotho

➤ Dept of Mathematics and Computer Science

The Department of Mathematics and Computer Science in the National University of Lesotho has a Computer Science Unit (CS Unit), which is responsible for ICT teaching and research. The whole CS Unit functions as a research group. Main research areas that the CS Unit explores are meant to improve government services and also to bridge the digital divide in Lesotho. The three main areas of research in the CS Unit are: (a) Communication Networks and Applications (CNA), (b) Artificial Intelligence and Human Language Technologies (AI & HLT), (c) Information Systems (IS), (d) Information Security, and (e) Data and Database Management Systems. The university research grant is the major source of funding for most projects.

- Research focus includes: Communication Networks and Applications; Artificial Intelligence and Human Language Technologies; Information Systems; Solar and Wind Energy, Energy Efficiency

(a) Communication Networks and Applications

Research in this area includes:

- Network Management and Services
- Next Generation Networks & Services Development
 - SIP-enabled instant messaging systems on IMS

- WiMax QoS on IMS

- Mobile Commerce Applications
- Mobile Advertising
- Intelligent Networks for e-government
- VoIP-based Computer Telephony Integration with Asterisk

(b) Artificial Intelligence and Human Language Technologies

Research in Artificial Intelligence in is the following areas:

- Machine Translation (at early stages)
- Speaker Recognition systems.
- Sesotho Speech recognition for bridging the digital divide.
- Text-to-speech in Sesotho for accessing government information and services.
- Development of Voice Browsers (VoiceXML interpreters)

It is worth noting that the projects above are currently research projects and laboratory work by individual researchers and have a very good potential depending on wider funding.

(c) Information and Cyber Security

The NUL has started a center for cyber security research. To address cybersecurity awareness, the research group specifically looks into research focused on cybersecurity, information security governance and Internet of things (IoT). The center for cybersecurity research is committed to providing professional training on cyber security and awareness programmes. The center will commence providing training on a part-time basis to people interested in cybersecurity from January 2019.

Research includes:

- Information Security Governance
- Cloud computing and security
- The IoT
- Digital Forensics
- Cybersecurity awareness
- Cyberwarfare
- Cyber intelligence
- Cybersecurity structures – organisational CERTs/CIRTs

➤ Lesotho College of Education

- Depts include: Dept of Information Technology
- Research focus includes: Technology-enhanced Learning

➤ Limkokwing University of Creative Technology

- Dept of Computer Technology
- Research areas of interest includes: Cloud Computing,

8.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and additional information during the IST-Africa Horizon 2020 Training Workshop on 02 November 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners
eHealth / mHealth	Health Information Management Systems / Electronic Health Records; Mobile First Aid system; Health Monitoring, Interoperability of systems; Systems supporting patients with TB and HIV	National University of Lesotho; Limkokwing University of CreativeTechnology; Ministry of Health
Technology - enhanced Learning	Indigenous knowledge systems using ICT; Technology integration in classroom; Creation of local digital content	National University of Lesotho; Limkokwing University of CreativeTechnology
eAgriculture	Enhancing crop productivity; ICT for Sustainable Agriculture and Rural Development; Mobile Application for farmers; Water management & irrigation systems	National University of Lesotho; Limkokwing University of CreativeTechnology; Lesotho Agricultural College; Department of Agricultural Research (MoAFS)
eGovernment	Public service delivery; Online application for student loans	National University of Lesotho; Limkokwing University of CreativeTechnology; MCST - Department of ICT

8.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components & Systems	Limkokwing University of Creative Technology (Faculty of Information and Communication Technology): Smart Embedded Components and Systems
Advanced Computing	National University of Lesotho (Dept of Maths and Computer Science): IP-enabled Home Automation
Future Internet	National University of Lesotho (Dept of Maths and Computer Science): Communication Networks and Applications (Network Management and Services, Next Generation Networks & Services Development), Mobile Management for the Future Internet, Cloud-based Communication Services, High Performance Computing Limkokwing University of Creative Technology (Faculty of Information and Communication Technology): Cloud Computing, Networks, Cyber Security, Privacy and Trust, Wireless Communication

	and all Optical Networks, Interactive multimedia
Content Technologies & Information Management	National University of Lesotho (Dept of Maths and Computer Science): Human Language Technologies, Technology-enhanced Learning Lesotho College of Education: Technology-enhanced Learning

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	National Health Training Centre: Specific focus on Cancer and HIV National University of Lesotho (Dept of Pharmacy and Nutrition): eHealth, Self-management of health, health data collection Limkokwing University of Creative Technology (Faculty of Information and Communication Technology): eHealth; Self-management of health, improved diagnostics; health data collection, methods and Data
Food Security, Sustainable Agriculture	National University of Lesotho (Faculty of Agriculture): Sustainable Agriculture
Energy	National University of Lesotho (Department of Mathematics and Computer Science): Solar Energy (Solar resource assessment – solar maps, Solar photovoltaic (PV), Solar thermal, Concentrated solar power); Wind Energy (Wind Resource assessment – wind mapping, Wind power); Hydro (Mini/micro/small hydros); Bio-energy (Bio-mass, Bio-gas); Energy Efficiency (Energy audits, Energy Management – demand side management, demand response, energy conservation, Smart Metering); Energy modelling
Inclusive and Reflexive Societies	Limkokwing University of Creative Technology (Faculty of Information and Communication Technology): eLearning
Secure Societies	Limkokwing University of Creative Technology (Faculty of Information and Communication Technology): Cyber Security National University of Lesotho: Cyber Security

Level of Research Maturity

Lesotho is gradually increasing the focus on research. This is reflected on the Government's emphasis on innovation and technology adoption and the development of applications and local content to service national requirements.

Being entirely surrounded by another country – and to a considerable degree economically reliant on that country (with many people from Lesotho working and earning their living across the border) brings its own challenges. This requires an increased policy focus on further strengthening the research capacity within the country, and especially in developing post-graduate programmes. As a result of IST-Africa training workshops in Lesotho, there is now a much higher level of awareness of the necessity for research activities to have a clear socio-economic purpose, and the requirement to focus on potential impact, and the potential benefits of multi-stakeholder research projects.

8.5 Innovation Spaces

Innovation Spaces are gradually emerging focused primarily around the *Basotho Enterprises Development Corporation*²⁸⁰ (BEDCO), the *School Technology Innovation Centre (STIC)* and *Innovation Hub* at the National University of Lesotho. The Vodacom Lesotho Foundation with support from BEDCO and UNDP is also funding the Vodacom Innovation Park in Maseru Mall, which was launched in 2015. A Technological Business Incubator was also established and hosted by the Ministry of Communications, Science and Technology, while Nesta partnered with UNDP to establish a Growth Innovation Lab in Maseru.

Established in 1980, **BEDCO** is a parastatal of the Government of Lesotho, with a mandate to support entrepreneurial capacity building programmes and delivery of business advisory and support services and business and technical training. BEDCO provides incubation space for start-up businesses as well as virtual incubation services, and in November 2014 launched an ICT-led business enterprise project, which it is hoped will lead to greater local entrepreneurial activity.

Established in May 2008, **STIC** is hosted by the Lesotho College of Education and targets in-service and pre-service teachers, learners and school principals. The objective is to inculcate basic scientific and technological literacy, visual and cultural literacy skills of student and promote adoption of new methods of teaching.

Established in 2015, the Vodacom Innovation Park is a technology-based business Incubator for young entrepreneurs in Lesotho focused on leveraging technology and mobile communications to make their businesses more competitive and productive.

The National University of Lesotho has established an innovation hub at its Roma campus. The innovation hub aims to support commercialisation of outputs from academic projects that have potential to strengthen diversification of the country's economy. The innovation hub is in part funded by the Government of Lesotho while other sources of funds are from private sector (i.e. NUL innovation fund, www.nulif.org). The innovation hub has also made calls to the general public with innovative ideas to be incubated to help Basotho nationals with innovative ideas to be supported to develop working products and services.

²⁸⁰ <http://www.bedco.org.ls>



Nesta²⁸¹ is a UK based, global innovation foundation supporting entrepreneurship. Nesta partnered with UNDP to establish the Innovation Growth Lab in Maseru, Lesotho.

²⁸¹ <https://www.nesta.org.uk/latest/>

9. MALAWI

9.1 Introduction

Malawi is situated in the southern part of the East African Rift Valley, located between Mozambique in the east, Tanzania in the north and Zambia in the west. It has a surface area of over 118,000 square km, which consists of 28 administrative districts (Balaka, Blantyre, Chikwawa, Chiradzulu, Chitipa, Dedza, Dowa, Karonga, Kasungu, Likoma, Lilongwe, Machinga, Mangochi, Mchinji, Mulanje, Mwanza, Mzimba, Neno, Ntcheu, Nkhata Bay, Nkhotakota, Nsanje, Ntchisi, Phalombe, Rumphi, Salima, Thyolo, Zomba). The population is estimated to be in the region of 19.6 million (July 2018 CIA World FactBook) with an average yearly growth of around 3.3% and a GDP per Capita of 1,200 USD. Sixty two percent of the population are between 15 - 64 years of age, with a literacy rate of 79.4%. The economy is heavily based on agriculture, with a largely rural population of 80% mainly engaged in small holder farming. Lilongwe, the capital city, has a population of 1.03 million (2018). The official languages are English and Chichewa, with other local languages also in use.



Malawi is among the world's least developed countries. The Government depends heavily on outside aid to meet development needs and faces challenges in building and expanding the economy, improving education, health care, environmental protection, and becoming financially independent. The foreign policy is pro-Western and includes positive diplomatic relations with most countries and participation in several international organisations. Natural resources include limestone, arable land, hydropower, coal and bauxite.

In relation to Communications, according to 2017 figures (CIA World Factbook), there were 11,234 fixed phone lines in use compared with 7.1 million mobile phones and 1.78 million Internet users.

In terms of ICT Infrastructure there is a submarine and terrestrial broadband network, a fibre cable infrastructure connecting Malawi and Mozambique, an expanded fibre infrastructure inside the country and a high level of mobile penetration. The Malawi Internet eXchange point became operational on 04 December 2008 and was funded through start up equipment assistance from KTH, Sweden through the College of Medicine Project. Tele centres were set up using ITU funding through MACRA and MPC. There are now over 100 operational telecentres in Malawi. The last mile connectivity project is part of the Regional Communications Infrastructure Project (RCIP) and the University Access project is supported by the World Bank. To encourage the use of ICT, the Government of Malawi has waived tax on the import of computers and accessories.

There are fifteen institutions of Higher Education: 4 public Universities (University of Malawi, Mzuzu University, Lilongwe University of Agriculture and Natural Resources and Malawi University of

Science and Technology), 7 public Polytechnics and specialised Colleges and 4 private Colleges. Plans are underway to unbundle the University of Malawi so that the four constituent colleges of UNIMA become standalone universities.

9.2 ICT Background

The Malawi Communications Regulatory Authority (MACRA) was established pursuant to Section 3 of the Communications Act, 1998 of the Laws of Malawi to regulate the country's communications sector. MACRA now draws its mandate from the Communications Act of 2016 to regulate and monitor the provision of communications services and ensure that, as far as it is practicable, reliable and affordable communications services are provided throughout Malawi. The Communications Act provide for the regulation of the provision of services in the electronic communications sector, posts, information society; for the establishment of the Malawi Communications Regulatory Authority, the Malawi Broadcasting Corporation and the Malawi Posts Corporation; and for matters connected therewith or incidental thereto.

MACRA implements ICT development Projects through project design, planning, monitoring and evaluation of ICT Projects in liaison with different stakeholders including, the Ministry of Information and Civic Education, rural communities, development partners (donors), and telecom operators. MACRA is responsible for the implementation of Universal Access Programs, which are aimed at addressing ICT access gap in the rural and remote areas of the country.

The Malawi's Vision 2020 statement policy sets the conceptual parameters for subsequent policy including National ICT policy (revised 2013) whose mission is to facilitate the creation of an enabling environment for efficient, effective, and sustainable utilization, exploitation, and development of ICTs in all sectors of the economy in order to attain an information-rich and knowledge-based society and economy. This policy has a dual focus. It aims at developing the ICT industry and sector and promoting the development and use of ICTs.

Given the benefits and opportunities offered by ICT, it is acknowledged that Malawi cannot effectively forge ahead with its development agenda without putting an appropriate framework of ICT in place to support and accelerate various national and sector initiatives and interventions at all levels of society. The ICT Policy was adopted in 2005 to develop the ICT sector and promote the development and use of ICTs focused on strategic ICT leadership, community access to ICTs and a responsive ICT legal and regulatory framework. It also includes a commitment to universal access, rural connectivity and liberalisation of the private sector involvement.

The ICT Policy aims to provide a direction as to how Malawi will turn the ICT potential into real benefits for its people. It also aims to put an appropriate institutional, regulatory and legal framework in place that should effectively support successful deployment and utilization of ICT in all sectors of national development. It is crucial that strong public-private partnerships exist in implementation of this policy. The Government will, therefore, continue to provide the right enabling environment for

both public and private sector participation in the development, deployment and utilization of ICT in both urban and rural communities through initiatives such as Universal Access projects. It is hoped that the policy will bring about organized and systematic ICT development and reduce ad-hoc, fragmented and uncoordinated development and utilization of ICT.

A lot of changes have taken place in the ICT sector since 2005 and this has prompted a revision of the ICT Policy to include Universal Access Issues and other associated standards to make recommendations for the adoption of the same. NCST was involved in the revision of the ICT Policy and the updated ICT Policy was published in September 2013. The ICT Policy together with the Malawi Digital Broadcasting Policy were both launched by the Vice President at the end of ICT Week which ran from the 3rd to 8th December 2013. The Government recognises ICT as a priority sector with the potential of turning around the economy. However, implementation of the ICT Policy may be affected by low levels of ICT literacy and awareness, dependency on imported goods and services, and competition for financial resources by other national priorities.

The Government of Malawi through the e-Government Department contracted consultants using UNDP funding to develop a National ICT Master Plan. This plan was approved by Government with the overall objective to implement the ICT policy. The plan was also used to develop the Malawi Growth and Development Strategy III. The ICT Master Plan spans 2014 to 2031, an eighteen-year duration, which is split into four separate plans. The first plan is a three-year plan for the period 2014 to 2016 whilst subsequent three plans span a five-year period each. The plan has clustered the ten priority areas identified in the ICT Policy into four logical strategic pillars, namely, Innovation and Human Capital Development, ICT Industry Development and E-Business, ICT Infrastructure Development and eGovernment and Growth Sector Development.

The Digital Broadcasting Policy is a guide developed for the smooth transition from analogue to digital television broadcasting. It entails segmentation of broadcasting services into content production and signal distribution meaning that television broadcasters will be responsible for content production and at the same time there is need for a separate entity to be responsible for distribution of the television signals to the consumers / television viewers on behalf of the broadcasters. Malawi has managed to meet the deadline set by ITU whereby all member countries are supposed to migrate to digital from analogue by June 2015.

The Malawi Growth and Development Strategies (MGDs) were developed to provide a single reference document for policy makers in Government; the Private Sector; Civil Society Organizations; Donors and Cooperating Partners on socio-economic growth and development priorities. The first MGDs ran from 2006 to 2011, second one ran from 2011 to 2016 and third one runs from 2016 - 2021. MGDS III draws some lessons from the earlier strategies in order to chart a path that takes the country forward in terms of sustainable and inclusive growth. It aims at building a productive, competitive and resilient nation by consolidating achievements of the earlier strategies.

Within the MGDS, ICT and telecommunications fall under the theme of Transport and ICT infrastructure, whose goal is to develop a safe, affordable, reliable, equitable and sustainable transport and ICT infrastructure development. Key strategies for achieving this include: Promoting the participation of community broadcasting stations, private couriers and privately owned telecommunication service providers; Promoting community ICT and multipurpose information centres, improving broadcasting distribution, content and coverage; Creating a conducive environment to attract investment in ICT infrastructure and services, Intensifying ICT research education and training in all sectors; and Developing capacity to generate reliable and accurate local content among others.

Planning for the third MGDs (2016 - 2021) took into account the implementation of international, regional, and continental development frameworks, protocols and treaties such as Agenda 63, SDGs, Vienna Program of Action for easy implementation, monitoring and reporting. NCST spearheaded the drafting of the ICT Chapter.

The establishment of the National Commission for Science and Technology (NCST) was provided for in the Science and Technology Act (No. 16 of 2003) to advance science and technology issues in Malawi. The National Research Council of Malawi and the Department of Science and Technology were integrated to form NCST following a Cabinet Directive of 20th October 2008.

NCST principally provides advice to the Government and other stakeholders on all matters related to science and technology in order to achieve a science and technology-led development. It derives its authority from the Minister responsible for Science and Technology to ensure that it reaches out to the highest levels and all sectors of social and economic development in the country.

The Government sees the establishment of the Commission as a key strategy for enhancing the development and application of Science & Technology in its development endeavours in order to accelerate the socio-economic development of the nation and improve the quality of life of its people. NCST's mission is to regulate, support, promote and coordinate the development and application of Science, Technology and Innovation so as to create wealth and improve the quality of life.

There are a number of ICT-related challenges facing Malawi, which include:

- “Brain drain” in the ICT sector due to low remuneration (essentially, brain-drain takes place at two levels: from Malawi to other countries especially within the SADC region, and from the public sector to the private sector).
- Inadequate institutional capacity at national, sectoral, and organisational levels.
- Negative attitude towards technology change.
- Human and financial resource constraints to the development of the ICT sector such as ICT infrastructure, high cost of telecommunications, and unstable and unreliable power.
- Outdated laws that support ICT development, deployment, and utilisation.
- Proliferation of sub-standard ICT schools, syllabi, and service delivery.

- Underdeveloped research and development capacity in ICT
- Lack of a national research agenda to provide a road map for research activities

9.3 Current ICT initiatives and projects

ICT Initiatives are currently ongoing at national level in the area of eGovernment (eGovernment Programme, Electronic Legislation enacted in 2016), Education and eLearning (Computers for African Schools Malawi, Pan African eNetwork), eInfrastructure (Regional Communication Infrastructure project, Malawi Sustainable Development Network Programme, MACRA Infrastructures projects, Malawi Research and Education Network, ESCOM Fibre Optic project), Digital Repositories (Malawi Library and Information Consortium, National Digital Repository), eHealth, eBanking, physical addresses and post codes, Biodiversity Information for Development (BID) and the Land Information System.

A fully-fledged Ministry of ICT was established in 2016 comprising of two technical departments namely; Information and E-Government with the mandate of providing policy direction and guidance in the production and dissemination of public information; coordinate and manage ICT development and services. The Ministry intends to provide an enabling environment for the development and usage of information and communication technologies.

9.3.1 eGovernment Programme

An eGovernment programme has been conceptualised as part of the Malawi Information and Communications Technology (ICT). The overall aim is to promote the country's socioeconomic development, supporting the aspirations of Vision 2020, with priority being given to ICT activities contributing to poverty reduction. The eGovernment element focuses on the modernisation and improved efficiency of public services. Specific strategies have been designed to:

- Improve productivity, efficiency, effectiveness and service delivery through institutional and organisational reforms
- Modernise the public service through the development and utilisation of ICT to support its operations and activities
- Promote e-government through government to-government, government-to-business, and government-to-citizens initiatives
- Promote the use of ICT to facilitate the decentralisation of government services and operations, and support the delivery of business and government services in rural areas
- Improve the basic skills of public officers by ongoing training
- Develop and enforce standards and best practice to guide the delivery of services to the public.

With funding from the Chinese Government of about USD135 million, the Department of eGovernment is implementing a number of ICT projects in the country over a 4 to 5-year period from 2013. The projects include establishment of a data centre, provision of e-services such as e-

immigration, e-national registration and identification system, sharable geographic information system, electronic document management system, e-Learning platform for the public sector, enhanced electronic communication systems, electronic marketing systems and electronic security systems.

Some of the software systems and applications undertaken within the e-Government initiative include a computer based Integrated Finance Management System (IFMIS), funded by the World Bank which aims to provide timely and accurate financial information while enforcing standardised integrated financial management reporting system for government Ministries and departments. The Payroll and Human Resource Management System purchased by the Government aims to overhaul the locally developed government establishment, personnel, payroll, pensions, loans management (PPPAI) that was initiated in 1998-99. Tithe Road Traffic Department's Traffic Management Information System (MaTIS) facilitates motor vehicle registration, issuing of driving licences and road permits.

The Malawi Immigration Department has also introduced a computer based system machine readable passport issuing system which is a fully integrated turnkey passport issuing system incorporating state-of-the-art biometric enrolment, issuing software, and Toppan digital passport printers. In addition, the Department has launched a new ICT innovation border control system in at its international airports, called the Integrated Border Control System, as part of its objective for computerise all its border posts.

Source of funding: Malawi Government, China and other development partners

Geographic scope and timeframe: National, Phase 1 2008 - 2013, Phase 2 2013 - 2017

9.3.2 Electronic Legislation Project

An eLegislation project is currently being funded under RCIP aimed to set up a responsive ICT Legal framework to facilitate competition, development and participation of Malawi in the Information Society and more particularly the legislation, among others, purports to

- (a) ensure that the development, deployment and exploitation of ICT within the economy and society and related legal provisions shall balance as well as protect community and individual interests, including privacy and data protection issues;
- (b) address ethical issues in the use of ICT to protect the rights of children and the under-privileged;
- (c) define favourable tax policies that promote ICT products and services that originate from within Malawi and provide a responsive and efficient regulatory environment, promote economic subsectors, assets accumulation and tax activities that arise from ICT use.

The Government expects to create an adequate, enabling and favourable environment for information and Communication Technology (ICT) users by developing an electronic legislation, which awaits input from institutions prior to passing it into law. The focus area includes 'legal

recognition of electronic messages', which the Bill acknowledges does not exist in the current legal framework. The Bill also addresses issues of protecting the public from cybercrime, eWaste and maintaining a secure space where data and intangible money could be stored, shared and legally and securely transferred. The Bill also has a provision for the establishment of Malawi CERT to lead in cybersecurity.

The eLegislation and Cybersecurity Act was enacted in 2016 and its objective is to set up a responsive information and communication technology legal framework that shall facilitate competition, development of information and communication technology and the participation of Malawi in the information age and economy and in particular

Source of funding: World Bank

Geographic scope and timeframe: National, enacted in 2016

9.3.3 Education and e-Learning projects

The Malawi ICT policy includes the promotion of ICTs in education systems at all levels in order to improve both the access and the quality of education, improve management of education systems and improve ICT literacy. It also has a few innovative initiatives in this area, committed largely to the promotion of integrated library and information services and networks. Both public and academic libraries have embarked on projects to implement integrated library management systems using open source softwares such as Koha and Dspace.

The Computers for African Schools Malawi has been active for the past decade. It incorporates academic and business representatives and is implemented by the British Council and Ministry of Education. It provides ICT training to teachers, provides computers and printers to schools and develops the ICT Curriculum for schools.

Source of funding: Malawi Government, British Council, India and other development partners

Geographic scope and timeframe: National, 2005 - 2010

Malawi urgently needs to expand the number of its health professionals to meet service delivery needs. In response to this, the Government has significantly increased the number of students taking medical and healthcare courses and challenged the Colleges to meet this requirement by adopting new methods of teaching. Researchers from University of Edinburgh are collaborating with Malawi's Medical, Nursing and Health Science Colleges to help them to develop the knowledge and skills necessary to design teaching and learning resources for delivery in new ways using CD, DVD and mobile phone. This process has involved three Train-the-Trainers workshops in Malawi facilitated by University of Edinburgh staff. The first, in April 2017, focused on the development of storyboards for a series of Virtual Patient (VP) scenarios. These are effective in contextualizing learning and stretching student learners.

Some libraries have embraced ICT to support the delivery of information. This is being achieved through the use of different computerised systems. Institutions including National Library service, LUANAR and National Commission for Science and Technology (NCST) have implemented “D-space” as a digital repository. All the documents are being uploaded into D-space for archiving.

Malawi National Examination Board (MANEB) in partnership with the National Bank of Malawi, Airtel Malawi Limited, Telekom Networks Malawi Limited, NICO Technologies and MACRA is upgrading its ICT System, which will ease the data handling of the Malawi School’s examination and other office work related to the writing of the examinations. Over time the registration for examinations will also be implemented electronically.

9.3.3.1 The Pan African eNetwork

An example of an e Learning initiative is the Pan African eNetwork, a Tele education connectivity which enables 5 African regional leading universities including the University of Malawi (Chancellor College) to be connected to a hub through satellite to 53 remote virtual classes distributed in all the 53 countries. Seven universities from India are connected via IPLC to the Hub located in Africa. India hosts the Tele education LMS portal comprising the University Tele-Education delivery system software that incorporates the e-learning, content management KMS (knowledge Management System) and digital library solutions. This project provides eServices with a priority on tele-education and telemedicine in order to build capacity. The Government of India has established the eNetwork through 3 centres in Malawi - eLearning at Chancellor College, Telemedicine at Kamuzu Central Hospital and e-VVIP at the State House. Free technical support was provided for five years as part of the project.

Source of funding: Government of India, Government of Malawi

Geographic scope and timeframe: Zomba and Lilongwe, 5 years [2009 - 2015]

9.3.4 The Regional Communications Infrastructure Project (RCIP)

RCIP is a Government of Malawi led intervention in the ICT sector, which aims to support policy and legislative reforms and to provide affordable Internet capacity to the nation.

The project is being funded by the World Bank and aims at facilitating the provision of a wet portion (submarine cable) solution to dry portion (overland) connectivity to eligible countries. It is managed by the Privatisation Commission, in partnership with MACRA and the eGovernment Department.

Under the Enabling environment activity, the project intends to review the Communication Act of 1998; build capacity amongst its agencies especially those involved in the policy and regulatory supervision of the ICT sector.

By September 2013, the Last Mile Connectivity Initiative, which is the third phase of the project was implemented. The initiative saw 145 sites being connected against a target of 100 and these

included Teachers Development Centres, Teachers Training Colleges, District and Regional information offices. The second phase of the project, which was completed by November 2013 saw the provision of Internet connectivity, terminal equipment, ICT equipment to all 30 District and Regional Information Offices in the country.

The project was completed in December 2015 when the construction of the international optic fibre network and delivery of Internet capacity to the VLP at Capital Hill was finalised. Government through the Ministry of Information, Tourism and Civic Education intends to launch the delivery of this infrastructure, which will reduce the costs hampering internet access to broadband in the country during 2016.

The Malawi Government obtained a loan from the International Development Association (IDA) towards the cost of the RCIPMW project.

Source of funding: World Bank, Government of Malawi

Geographic scope and timeframe: National, 2009 - 2015

9.3.5 Malawi Sustainable Development Network Programme (SDNP)

SDNP was a pioneering UNDP funded project that implemented the provision of Internet services in the country. SDNP was put in place to help countries implement Agenda 21 by facilitating access to information about sustainable development and also encouraging participation in decision making for sustainable development. SDNP started its operations in the 1990's and at the moment it is being hosted by the National Commission for Science and Technology after UNDP stopped funding its operations in 2011. Currently plans are underway to have SDNP registered as a company limited by guarantee with NCST as one of the Directors.

SDNP has enhanced the capacity of stakeholders to use computer mediated communications, including the Internet. This has been done through training and the provision of equipment to encourage users to connect.

Furthermore, the project has helped to enhance the capacity for open and participatory decision-making processes, and strives to have a role in encouraging local and community based involvement in sustainable development.

Some of the SDNP services include: Full Internet Services, Installations and Maintenance, World Wide Web Services, Leased Line Access, Wireless network access, Domain Name Services, Domain and Subdomains registration, Gateway Service and the IPv4 and IPv6.

Source of funding: UNDP, National Government

Geographic scope and timeframe: National, 1990-2011

9.3.6 MACRA Infrastructures Projects

Malawi Communications Regulatory Authority (MACRA) is implementing telecommunications infrastructure development through the establishment of tele-centres in several rural areas of the country through ITU's, World Bank, MACRA and Malawi Post Office support. The majority of Malawians (about 80%) live in the rural areas where access to basic ICT services is not readily available therefore the implementation of the ITU/MACRA/MPC tele-centre project has brought great enthusiasm and uptake of ICT services to the extent that the Government of Malawi is embarking on a "Connect a Constituency" Project to make sure that there is at least one Multipurpose Community Telecentre (MCT) in each constituency. Fifty-six tele-centers were established from 2010 – 2013 to support access to ICT enabled applications i.e. e-education, e-agriculture, e-health etc. Malawi is ensuring that it puts in place enabling policy, legal and regulatory framework to ensure provision of affordable and accessible ICT services to its citizens especially those in the rural areas.

Additionally Malawi has benefited under the ITU disaster relief through ITU satellite phones provided for emergency communication services in the flood-hit districts. The assistance has gone a long way in facilitating easier access to the affected people and providing for their immediate needs. This is due to the anticipated rainy season that causes severe flooding especially in the southern part of Malawi. ITU also paid for the airtime.

MACRA is undertaking research with Chancellor College in relation to the potential uses of TV White Spaces.

With funding from the Foreign and Commonwealth Office, the Commonwealth Telecommunication Organization (CTO) in conjunction with MACRA has developed a National Cyber Security Strategy for Malawi with a log framework comprising of the Vision statement, strategic goals, actions, outputs, time frame, indicators and lead organisations to help the country respond to the increasing threats in the cyber world.

MACRA is also on the drive to develop smart cities starting with Blantyre in an effort to mitigate the negative impact of urban population growth and rapid urbanisation. The aim is that Blantyre will be a smart city by 2020. The smart city will interconnect human capital, social capital, and ICT infrastructure in order to address public issues and achieve a sustainable development and also improve the quality of life for citizens. It aims to support sustainable development and enhance the quality of life for citizens. MACRA intends to facilitate this initiative through City Councils, the Ministry of ICT and Civic Education, Ministry of Tourism, Telecommunication Operators (Fixed and Mobile Operators, ISPs), Communities in the country. The initial phase of the initiative will focus on engagement with Blantyre City Council.

9.3.7 Malawi Library and Information Consortium (MALICO)

MALICO was established on 7 May 2003 and launched its VSAT Network, giving academic connectivity from north to south of Malawi in 2005, leveraging 4 VSATs purchased with the support of OSISA, World Bank and Dossani Trust. It pioneered the establishment of the Malawi Research and Education Network. It contributes to the subscription of eResources and the production of local and relevant content for Malawi's repositories. Workshop have been organised in Malawi to develop Open Access policies for research organisations.

MALICO's objectives include:

- To encourage national, regional and international cooperation among information stakeholders,
- To influence information policy at the national level,
- To work for adequate ICT infrastructure for members, especially sufficient internet bandwidth
- To assist in the development of appropriate ICT skills at all levels,
- To facilitate access to electronic journal articles in international databases,
- To organise and digitise Malawian content,
- To provide information consultancy.

Current activities include establishment of a national digital repository at the National Library Service and subscription to international e-resources for the academic community.

MALICO has been working with organisations like INASP (International Network for the Availability of Scientific Publications) and EIFL (Electronic Information for Libraries). INASP aims at improving access to, and production and use of, research information and knowledge for sustainable development. Through INASP funding, MALICO has developed a four-year strategic plan from 2014 -2018 so that the consortium follows a clear road map and becomes self-sustainable. Although there are many areas in which the consortium needs strengthening, the strategic plan covers some of the areas deemed to be a nexus between previous and future activities of the consortium such as training of trainers in information literacy, library marketing and advocacy and licensing and negotiation skills.

MALICO in collaboration with EIFL, an organization that works with libraries in more than 60 developing and transition countries has enabled access to knowledge for education, learning, research and sustainable community development. Some of MALICO's benefits from EIFL include:

- Licencing- through central negotiation with publishers, EIFL negotiates highly discounted prices and fair terms of use to increase access to scholarly material that is essential for research and education.
- Open access: EIFL advocates for the adoption of open access policies and mandates. EIFL also builds capacities to launch and sustain open access repositories.

- Copyright and libraries: EIFL seeks to address these issues by promoting fair and balanced copyright laws that support libraries in providing access to knowledge.
- Free and open source software for libraries: EIFL supports the deployment of free and open source software and provides the necessary training, enabling libraries to achieve significant cost savings.

Sources of funding: MALICO members, INASP, EIFL

Geographic scope and timeframe: National, ongoing

9.3.8 Malawi Research and Education Network (MAREN) – Malawi NREN

The Malawi Research and Education Network (MAREN) is a non-profit national organization formed in October 2005 with the aim of establishing sustainable communication and networking among research and education institutions in Malawi. Its main mandate is to offer a single focus for pursuing excellent Internet connectivity for the Tertiary Education and Research Sectors in Malawi. MAREN has assisted its member institutions to renumber their networks to be identified globally as research and education institutions. The availability of national and international fibre is a catalyst for the implementation of the physical network. It builds on the head start offered by the Malawi Library and Information Consortium (MALICO) VSATs network but aims to go further by providing fast fibre connectivity linked to neighbouring countries, to the rest of Africa and to the EU academic network (GEANT).

MAREN was registered as a not-for-profit company limited by guarantee in late 2009 and has now set up its own Secretariat with full time personnel based at Chancellor College. The National Commission for Science and Technology, University of Malawi and Mzuzu University are represented on the board of Directors. Currently MAREN has been involved in the following activities:

- Completed the development of a fibre campus for the University of Malawi sites: College of Medicine and related medical research complexes, Blantyre Campus of Kamuzu College of Nursing and the Malawi Polytechnic.
- Working with ESCOM, the Electricity Supply Corporation of Malawi, to utilise the two fibre strands given to MAREN for academic connectivity between Blantyre and Lilongwe.
- Working with MACRA, Malawi Communications Regulatory Authority, for harmonious regulatory conditions for academic connectivity
- Working with EU and UbuntuNet Alliance for research and education networking for the implementation of the EU AfricaConnect Project
- Collaborating with MISPA on the activities related to the Malawi Internet Exchange and hosting it at Malawi College of Medicine.
- The Malawi National Grid Initiative will be another of the early outcomes.

Through UbuntuNet Alliance MAREN is a beneficiary under the Africa Connect and Africa Connect 2 infrastructure projects.

Source of funding: UbuntuNet Alliance, MAREN members, Malawi Government, RCIP

Geographic scope and timeframe: National, ongoing

9.3.9 ESCOM (Electricity Supply Cooperation of Malawi) Fibre Optic project

ESCOM has laid fibre-optic cables that will connect Mozambique with the Zambian border town of Mchinji to ease communication problems. The cable networks connect Tete in Mozambique and Mchinji provide services ranging from voice, data, fax and radio communication system.

The cables were laid on ESCOM's power lines throughout Malawi to build the networks that form the country's national fibre-optic backbone. They provide voice, data, fax and radio communication systems. The project commenced in 2008 and by 2012 there was 2,112 kms of fibre optic cable laid in urban areas This increased to 5,176 kms of fibre optic cable in 2016 due to increased private sector investment and RCIPMW project interventions.

In addition, the cables will also provide ESCOM with a communication system linking the power generation center with control centers and, eventually, with the regional office. At the end of the project ESCOM will have enough bandwidth to lease to ISPs (Internet service providers), mobile service providers, television companies, and government and education institutions.

Through a partnership between Huawei Technologies and Escom, Malawi is undertaking a massive fibre network project with investment of \$23 million to lay fibre across 28 districts within the country improving internet access and speeds while integrating government operating systems such the Integrated Financial Management Information Systems (Ifmis), Human Resources Management Information Systems (HRMIS), National Registration Bureau (NRB), Malawi Traffic Information Systems (Martis) and the immigration Department. The funding is a concessional loan with China for the Malawi National fibre Backbone Project. The connectivity, which will be via aerial fibre, using ESCOM electricity transmission poles, will have drop points at Capital Hill in Lilongwe, Government Office Complex in Blantyre and government offices in Zomba.

Currently, the state owned company Escom has been split into two companies, Escom for distribution of electricity and Electricity Generation Company (Egenco) which is now responsible for generation of power to improve the efficiency of power availability.

Source of funding: Malawi Government through ESCOM, China-Huawei

Geographic scope and timeframe: National, 2008 - ongoing

9.3.10 National Digital Repository (NDR)

In 2009, the National Library Service (NLS) began collaborating with the Institute of Development Studies (IDS, UK) on the Malawi Development Exchange (MDE), a project to facilitate the widening

of access to development information in Malawi, by collecting and disseminating Malawian research. MDE, based at the NLS, has established procedures and processes for collecting and digitising research documents and is making these available through a website with a supporting online community or related professionals. NDR is implemented by MALICO.

Additionally, MALICO, with the support from the International Network for the Availability of Scientific Publications (INASP) and eIFL.net, developed a proposal for the establishment of a digital repository for research in Malawi.

The National Digital repository of research from Malawi aims at collecting research outputs from Malawian institutions and building their capacities in global knowledge sharing. It is envisaged that the increased accessibility and visibility of Malawian research outputs will increase their impact on policy and bring more transparency to research institutions. A second aim is to link to, learn from and utilise the related work, ensuring close collaboration, identifying opportunities for further collaboration and avoiding duplication of effort.

The project also includes a training component for technicians, researchers, non-governmental organisations and policy makers to enable them to repackage their research for different audiences to input such and on how to use the repository.

Efforts by the University Libraries, the National Library Service, the National Commission for Science and Technology and the National Archives are also underway to have the Students Degree Projects; Past Exam Papers; Theses and Dissertation; the Malawiana Collection; local scientific papers and the Presidential speeches digitised. This will increase visibility and accessibility of Malawi's local content on the Internet that has few information resources on Malawi's content at the moment.

Source of funding: Institute of Developmental Studies, UK; Malawi Government

9.3.11 eHealth Projects

The College of Medicine is undertaking research related to magnetic resonance imaging in Malaria research to support common neurological disorders and improving clinical services for patients receiving care at the teaching hospital. Complex scans are sent to Michigan State University over VSAT for further investigation. The MRI Scan is also serving neighbouring countries such as Zambia and Mozambique to detect issues related to malaria and brain disease, spinal cord, heart and great vessel, head and neck diseases etc.

The Ministry of Health is leveraging DHIS2 to collect aggregated health indicators at district health office level. The system was customised with support of Technical Assistance through donor financial aid. The Malawi government sustains the day to day running of the system.

A number of NGOs (Baobab Health Trust, D-Tree, Luke International) who are working in partnership with the Ministry of Health to deploy eHealth projects with support from PEPFAR.

Furthermore, the Government of Malawi and UNICEF established an air corridor to test potential humanitarian use of unmanned aircraft systems (UAS), which will run for a maximum distance of 40 km. It became fully operational in April 2017. The corridor is designed to provide a controlled platform for the private sector, universities, and other partners to explore how UAS can be used to help deliver services that will benefit communities. The Humanitarian UAS Testing Corridor will facilitate testing in three main areas from 2016 - 2018:

- Imagery – generating and analyzing aerial images for development and during humanitarian crises, including for situation monitoring in floods and earthquakes
- Connectivity – exploring the possibility for UAS to extend Wi-Fi or cellphone signals across difficult terrain, particularly in emergency settings
- Transport – delivery of small low weight supplies such as emergency medical supplies, vaccines and samples for laboratory diagnosis, including for HIV testing

Source of funding: Malawi Government, Michigan State University, PEPFAR

Geographic scope and timeframe: National, 2009- current, UNICEF project (2016 - 2018)

9.3.12 Mobile Innovations and eBanking

The two mobile service providers (Airtel and TNM) introduced Mobile Money and mobile bill payments - Mpamba and Airtel Money. To use the service one has to register for the mobile money service. The service has been extended to enable client to pay bills as well. These services support citizens who do not currently have access to traditional bank accounts to deposit, withdraw and transfer cash using a text message.

Banks are using ICT to provide Internet banking to its clients to support funds transfer and to support real-time access to bank balances online. Some banks have implemented mobile SMS alerts to inform clients of transactions on their accounts.

9.3.13 Digital Migration Project

The Digital Migration project started in the 2010/11 at an estimated cost of US \$ 10 Million and is funded by the Malawi Government under Public Sector Infrastructure Program (PSIP). The overall aim of this project was to improve communication between government offices, improve ICT governance, improve access to government information and services, and reduce infrastructure costs by providing reliable, fast and adaptive ICT infrastructure and ICT systems and an enabling environment that will facilitate provision of e-services thereby enhancing public service delivery. The project will target 3 core enablers of digital development i.e. digital ecosystem, digital connectivity and digital platform and services.

Under the digital platform and services the main goal was to introduce an Active Digital Television signal in Malawi and with a target of smooth migration from analogue to Digital Terrestrial Television

Broadcasting. It was an ITU driven project and Malawi is the signatory to the ITU June 17, 2015 Migration Agreement.

The Malawi Digital Broadcasting Policy was approved by Government in July 2013. The network was commission on 31st December 2013. The project aspired to reach out to 90% of the Malawian Population. As at September 2017, the network is carrying 20 TV channels and 13 Radio channels.

Source of funding: Malawi Government

Geographic scope and timeframe: National, 2010 - Current

9.3.14 Malawi Internet Governance Forum

Malawi launched the Internet Governance Forum on 23 July 2014 following a consultative meeting with academia, private sector and NEPAD Secretariat. Internet Governance affects a wide range of social and political issues including IP, cyber security, privacy and domain management. The overall objective of the Malawi Internet Governance Forum (Mw-IGF) is to establish a multi-stakeholder process that will shape the development of Malawi's Internet economy by: increasing awareness and build capacity at national level; facilitate consultation with relevant stakeholders; make recommendations in relation to emerging issues; shape national policy and contribute to strengthening the multi-stakeholder dialogue model for Internet Governance in the SADC region and Africa.

9.3.15 Physical Addresses and Post Codes for Malawi

The postal sector is implementing a project addressing physical addresses and post codes for Malawi. It aims is to improve mail delivery and utility service provision in Malawi. MACRA was designated as secretariat for this project. The post code component will be implemented first and then physical addresses assigned.

In 2016/17 financial, MACRA launched a pilot project with selected areas in Blantyre city (Chinyonga, Namiwawa, Ndirande and Lilangwe). During 2017/18 the project will move into two sites for Lilongwe and two pilot sites for Mzuzu.

9.3.16 Biodiversity Information for Development (BID)

Malawi became a participant of the Global Biodiversity Information Facility (GBIF) in January 2015 with NCST as the node for Malawi GBIF. This project aims to mobilise biodiversity data in Malawi and share it with the GBIF network portal so that it can be easily accessible globally via the internet. The biodiversity data is being shared the "Integrated publishing toolkit (IPT)" which is being hosted at NCST. Biodiversity data is also being managed centrally through the use of this publishing toolkit.

9.3.17 Land Information System

Malawi is a beneficiary in the World Bank funded projects focused on Land information implemented through the African Technology Policy Studies Network (ATPS). The LandInfo App is used for collecting information on soil and climate characteristics in order to make informed decisions on agricultural production and sustainable land management practices.

9.4 National ICT Research Capacity and Priorities for Cooperation

9.4.1 National Priorities

National ICT Research Priorities include:

- eHealth - To enable faster, safer, better healthcare by placing medical information in the right hands at the right time; Improve patient safety; Provide better access to specialist care in all geographic areas through the increased use of technology and information systems, such as tele- medicine. Institutions involved include: College of Medicine, Kamuzu College of Nursing, Chancellor College
- eAgriculture - Getting and sharing information among fellow farmers; ability to include market competitiveness. Institutions involved include: LUANAR, Department of Extension Services (Ministry of Agriculture)
- eInfrastructure and Entrepreneurship - To ensure that Internet is accessible in remote areas; Tool for socio economic development. Institutions involved include: MACRA, Chancellor College, Polytechnic of Malawi
- eGovernment and eDemocracy - Campaigning and voting tool; Provides accessibility to politicians and policy makers. Institutions involved include: eGovernment Department; Chancellor College, Electoral Commission
- Technology-enhanced Learning - To provide freedom to learn when and where at own pace; provides high levels of coverage; ensures consistency of learning materials to all students; Cross-platform support. Institutions involved include: Chancellor College, Kamuzu College of Nursing, College of Medicine, Polytechnic, Mzuzu University
- Digital Libraries and Repositories - Exposing local content to international communities; preserving information; Easy access to information. Institutions involved include: MALICO, National Library Service, University of Malawi, Mzuzu University, LUANAR

9.4.2 National Research Capacity and Priorities for Cooperation

The table below provides an overview of some of the universities with ICT/Engineering Courses:

Institution	Location	Total Students	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Undergraduate Students	Post-Graduate (Masters, PhD)
University of Malawi, Chancellor College	Zomba	4,071	ICT	6	3,925	146
Polytechnic of Malawi	Blantyre	3,345	Engineering	10	3,300	45
Lilongwe University of Agriculture and Natural Resources	Lilongwe	1,620	Engineering	10	1,620	207
Mzuzu University	Mzuzu	2,500	ICT Librarianship	5	2,475	35
Department of Information Systems and Technology Management Services	Lilongwe and Blantyre	1,500	ICT	15	1,500	
University of Livingstonia (UNILIA)	Rumphi	1000	ICT Computer Engineering	5	1000	0
Malawi University of Science and Technology (MUST)	Thyolo	500	Innovation Computer Science in Network Security	6	475	25
DMI St. John Baptist University	Mangochi	500	Engineering in Computer Science	5	500	0
Daeyang University	Lilongwe	166	ICT	3	166	0

The following universities and research centres in Malawi are undertaking ICT-related initiatives

- University of Malawi - Chancellor College²⁸²
 - Research Focus - Use of ICT in Science and Engineering: e-learning, mobile health, ICT architecture, IT Audit, operating systems, ICT for development, software engineering, searching, usability, Computer Network Management and Internet Security

²⁸² <http://www.chanco.unima.mw/>

- University of Malawi: Polytechnic²⁸³, Engineering Department
 - Research Focus - Use of ICT in Science and Engineering, internet research and security, software development, Telecommunications, Geographic Information Systems- remote sensing, Environmental health
- Mzuzu University²⁸⁴ - ICT and Informatics Department
 - Research Focus – Electronic library and Information systems, coding and cryptography, digital libraries, renewable energy, Internet research, eHealth
- Lilongwe University for Agriculture and Natural Sciences - Engineering Department
 - Research Focus- ICT for Agriculture, Sustainable environment, e-learning
- Malawi University of Science and Technology⁷⁰ - Information Technology and management systems

9.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and discussion during the IST-Africa H2020 Workshop on 28 November 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners include
eHealth / mHealth	Health Information Systems/Electronic Health Records; Maternal, Newborn and Child Health (MNCH); Health diagnosis and Surveillance - Malaria, hypertension, diabetes, cancer; Mechanisms and alarms to deal with compliance issues (remembering to take medication, attend clinic etc); Telemedicine and remote diagnosis	Chancellor College (Department of Computer Science, Department of Physics); College of Medicine; KCN; Mzuzu University; Baobab Health Trust; Malawi Liverpool Welcome Trust, University of Livingstonia; Polytechnic of Malawi; MUST;
eAgriculture	Food Security; Agri-food based applications; Market Information; Aflatoxin management in food crops	LUANAR; Chancellor College; Department of Agricultural Research Services; Mzuzu University
Technology-enhanced Learning	mLearning; Distance Learning	LUANAR; Chancellor College; Mzuzu University; National Library Services, MUST (Institute of Technology).
Environment	Renewable Energy; Waste Management including eWaste	LUANAR; MUST (Climate and Earth Science Dept); University of Malawi (Chemistry Dept), Polytechnic (Dept of Environmental Science and

²⁸³ <http://www.poly.ac.mw>

²⁸⁴ <http://www.mzuni.ac.mw>

		Technology)
eGovernment	Public Service Delivery; eCommerce Applications	Chancellor College, Polytechnic; eGovernment Dept.

9.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	<p>Chancellor College, University of Malawi (Dept of Computer Sciences): Smart Embedded Components and Systems, Organic Electronics, Large Area Integration, Smart Integrated Systems, Systems of Systems and Complex System Engineering</p> <p>Polytechnic, University of Malawi (Department of Computing and Information Technology): Smart Embedded Components and Systems, Organic Electronics, Large Area Integration, Systems of Systems and Complex System Engineering</p> <p>National College of Information Technology: Smart Embedded Components and Systems</p> <p>College of Medicine, University of Malawi: Smart Embedded Components and Systems, Organic Electronics, Smart Integrated Systems</p>
Advanced Computing	<p>Chancellor College, University of Malawi (Dept of Computer Sciences): Interconnect and Data Localisation Technologies, Cloud Computing, Parallel Computing and Simulation Software</p> <p>Polytechnic, University of Malawi (Department of Computing and Information Technology): Interconnect and Data Localisation Technologies, Cloud Computing, Parallel Computing and Simulation Software</p> <p>Mzuzu University (Department of Information, Sciences and Communication): Interconnect and Data Localisation Technologies, Cloud Computing</p>
Future Internet	<p>Chancellor College, University of Malawi (Dept of Computer Sciences): Cloud Computing, White Spaces, Networks, Software and Services, Wireless Communication</p> <p>Polytechnic, University of Malawi (Department of Computing and Information Technology): Cloud Computing, Networks, Software and Services, Wireless Communication, Immersive Interactive Multimedia</p> <p>Mzuzu University (Department of Information, Sciences and Communication): Cloud Computing, Networks, Software and Service</p>
Content Technologies & Information	Chancellor College, University of Malawi (Dept of Computer Sciences): ICT Infrastructure, Language

Management	<p>Technologies, Digital Repositories, Digital Preservation, Technology-enhanced Learning, Machine Learning</p> <p>Polytechnic, University of Malawi (Department of Computing and Information Technology): Advanced Data Mining, Technology-enhanced Learning</p> <p>Mzuzu University (Department of Information, Sciences and Communication): Digital Repositories, Technology-enhanced Learning, Analytics</p> <p>Kamuzu College of Nursing (Community and Mental Health Dept): Technology-enhanced Learning</p>
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Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>College of Medicine, University of Malawi: Telemedicine</p> <p>Kamuzu College of Nursing (Community and Mental Health Dept): Telemedicine</p> <p>Mzuzu University (Dept. of Health Sciences; Department of Nursing and Midwifery and ICT Dept): Health Information Systems. eHealth</p> <p>Chancellor College (ICT Dept.): Mobile applications in e-health</p> <p>Polytechnic, University of Malawi (Dept. of Environment): Environmental health, health information system</p> <p>Malawi University of Science and Technology (MUST): Health information system. eHealth</p>
Food Security, Sustainable Agriculture	<p>LUANAR (Dept. of Crop and Soil Sciences, Dept. of Home Economics and Human Nutrition, Dept. of NRM)</p> <p>Mzuzu University: Sustainable Food Production Systems</p> <p>Lilongwe University of Agriculture & Natural Resources: Sustainable Food Production Systems</p> <p>Department of Agricultural Research Services: Sustainable Food Production Systems</p>
Climate Action, Environment, Environment, Resource Efficiency and Raw Materials	<p>Lilongwe University of Agriculture & Natural Resources: Water Resource Management</p> <p>Polytechnic: Water Resources and Supply Managemnet</p>
Secure Societies	<p>Chancellor College, University of Malawi (Dept of Computer Sciences): Trustworthy ICT</p> <p>Polytechnic, University of Malawi: Trustworthy ICT</p>

Level of Research Maturity

Malawi has a good research base and experience of collaborative research with participation in over **20** projects and securing over **€3 million** in funding under FP7: ICT (2 projects), INCO (1 project),

Infrastructure (5 projects), Environment (2 projects), Health (8 projects), KBBE (1 project) and Science in Society (1 project). Mzuzu University, National Commission for Science and Technology, UbuntuNet Alliance and University of Malawi have a track record in FP7.

Up to September 2018, Malawi organisations have secured participation in ten Horizon 2020 projects with research funding of over €2.625 million across a range of thematic areas:

- INFRA, H2020-INFRA-SUPP-2014-2 - **MAGIC** (UbuntuNet Alliance); **Sci-GaIA** (UbuntuNet Alliance); **TANDEM** (UbuntuNet Alliance)
- LEIT - ICT-39-2015 - **mHealth4Afrika** (RIA) - Chancellor College, University of Malawi
- H2020-WATER-2015-two-stage - **WATERSPOUTT (RIA)** - University of Malawi
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA) - National Commission for Science and Technology
- H2020-SC1-2016-RTD - **Perform 2 scale** (RIA) - The Registered Trustees of the Research for Equity and Community Health Trust; **SURG-Africa** (RIA) - University of Malawi
- H2020-SFS-2016-2 - **InnovAfrica** (RIA) - Soils, Food and Healthy Communities (Sfhc) Limited and University of Malawi
- H2020-MSCA-ITN-2017 - **ANTHUSIA** (MSCA-ITN-EJD) - University of Malawi

Institutional Research capacity was validated through statistics obtained from the National Council for Higher Education (NCHE) which is an institution mandated to accredit education institution programmes in Malawi. In addition, the data was also verified through the records available from the NCST's Directory for Research and Development institutions in the country.

Most of the research is being conducted at the public Universities (University of Malawi (Chancellor College, Polytechnic, College of Medicine and Kamuzu College of Nursing); Lilongwe University of Agriculture and Natural Resources (LUANAR); Mzuzu University and the newly established Malawi University of Science and Technology (MUST)) as well as research institutions. The National Commission for Science and Technology is providing active support to the research community through IST-Africa activities.

9.5 Innovation Spaces

Innovation Spaces were first launched in Malawi in 2014, with the launch of the Global Center for Food Systems Innovation²⁸⁵ at Lilongwe University of Agriculture and Natural Resources; Polytechnic Innovation Hub in Blantyre, Lilongwe mHub²⁸⁶ and InCUBE8²⁸⁷.

In early 2014, the Global Center for Food Systems Innovation²⁸⁸ at Michigan State University, established a regional innovation hub in partnership with the Lilongwe University of Agriculture and

²⁸⁵ <http://gcfsi.isp.msu.edu/>

²⁸⁶ <http://www.mhubmw.com/>

²⁸⁷ <http://www.incube8mw.com/>

²⁸⁸ <http://gcfsi.isp.msu.edu/>

Natural Resources, with financial support from USAID. This innovation hub is focused on agricultural and food systems innovation, starting with developing and introducing multi-purpose legumes, which produce both food for humans and fodder for animals and will supplement growing of maize.

In May 2015 UNICEF collaborated with the Polytechnic, University of Malawi to establish the Polytechnic Innovation Hub focused on engagement with youth, academia, government, private sector and development partners. It aims to support UNICEF's innovation efforts in Malawi. The hub is hosted with the Chichiri Campus of the Polytechnic with operational funding from UNICEF.

In late 2015 Lilongwe mHub was set up as a pre-Incubator and co-working space with funding from Hivos Southern Africa. It is specifically targeting young tech entrepreneurs - students and graduates who wish to leverage their technical skills to set up start ups. It aims to support software development, mentoring and community building. It has signed a cooperation agreement with the UNICEF Innovation Hub hosted at Polytechnic of Malawi.

InCUBE8²⁸⁹ was set up in 2016 as a business incubator, providing mentorship, technical and financial support, with a particular focus on youth led teams addressing social challenges. It is partnering with the Tony Elumelu Foundation Entrepreneurship Programme²⁹⁰.

Growth Accelerator Malawi²⁹¹ is being implemented by mHub in partnership with GrowthAfrica and Accesserator (Dutch investment firm). It has a particular focus on supporting emerging entrepreneurs with finance (investment of up to \$40k) and technical assistance over twelve months. UNDP and the Royal Norwegian Embassy support this accelerator program.

²⁸⁹ <http://www.incube8mw.com/>

²⁹⁰ www.tonyelumelufoundation.org/

²⁹¹ <http://growmalawi.com/>

10. MAURITIUS

10.1 Introduction

Mauritius is situated in the South West Indian Ocean, slightly over the tropic of Capricorn, in latitude 20° south and longitude 57° east of Greenwich. It is 2,000 km off the east coast of Africa and some 855 km east of Madagascar. An island of volcanic origin with an area of 1,864 km², it is almost entirely surrounded by coral reefs. There are nine administrative districts and three dependencies*; Agalega Islands*, Black River, Cargados Carajos Shoals*, Flacq, Grand Port, Moka, Pamplemousses, Plaines Wilhems, Port Louis, Riviere du Rempart, Rodrigues* and Savanne.

The population is estimated at 1.3 million inhabitants in 2016 with a literacy rate of 89.8% (Statistics Mauritius 2017). In 2017, seventy percent of the total population was between 15 and 64 years of age. Port Louis, the capital, has a population of 135,000 (Statistics Mauritius 2017). The languages are Creole, Bhojpuri, French and English.

Mauritius has established itself as one of the leading economic reformers in Africa. Strong institutions in a politically stable and thriving business environment and effective use of trade preferences particularly with Europe and India have been instrumental in driving growth and facilitating an impressive economic diversification.

Mauritius has diversified its economy from sugarcane into tourism, textiles, financial services, and Information and Communication Technology (ICT). The ICT sector has recently been propelled into a major pillar of the Mauritian economy as the Government considered ICT to be a key enabler for economic and sustainable development. In 2018 the ICT sector contributed 5.6% of GDP and employing around for c. 23,000 people (Board of Investment, 2018). Over the past 4 years, Mauritius has moved up the GCI ranking of the World Economic Forum Global Competitiveness Report from 54 to 45 (Global Competitiveness Report 2017). In terms of Network Readiness Index and ICT Development Index Mauritius is ranked 49th with a score of 4.4 and 72nd with a score of 5.55 respectively for 2017. Mauritius is among the most competitive and successful economies in Africa. It was ranked at 49th position among 190 countries in the World Bank's 2017 Doing Business Survey. The country is also ranked among the top 10 countries in the world in terms of Cybersecurity. According to ITU's Cybersecurity index Mauritius is ranked 6th globally in 2018.

In relation to Communications, according to the Information and Communication Technologies Authority, there were 413,100 fixed phone line subscriptions (32.6% penetration rate), 1.8 million mobile phone subscriptions (145% penetration) and more than 1.2 million internet subscriptions (98.6% penetration) in 2017.



The telecommunications sector was liberalised at the end of 2001 and has evolved from a classical analogue network to a fully digital one. Mauritius is linked to the South Africa Far East (SAFE) submarine cable (2002), the Lower Indian Ocean Network (LION) submarine fibre cable (2009), and LION2 submarine cable (2011). IOX CABLE Ltd, a subsidiary of INDOI LTD, signed a MOU with Mauritius Telecom to build an undersea cable system – Indian Ocean XChange Cable System. This US\$150 million cable project will allow Mauritius to have a third independent undersea cable connectivity to Africa and the rest of the world and in turn reinforce Mauritius, as an emerging innovation giant in Sub-Saharan Africa. The IOX cable system will be the first open access cable system in the region and offer the opportunity for any licensed operators to benefit from the latest technology and seamless access, throughout the life cycle of the cable system. The IOX undersea cable system design will also allow it to connect to existing and future undersea cable projects off the East coast of Africa. The IOX Cable is expected to be ready for commercial service by the first quarter of 2019.

An Independent Regulatory Authority (ICTA) was established in 2002. There are currently 2 Fixed Line Operators, 3 Mobile Operators and 13 ISPs. The National Internet Exchange Point (NIXP) is hosted at the Government Online Centre. A national Public Key Infrastructure (PKI) Ecosystem is in place.

In terms of Fibre connectivity to the home (FTTH) at this stage the whole island is connected to the Fibre optics cable, which offers internet connection of a minimum speed of 10 Mbps and a maximum speed of 100 Mbps. In 2017, the broadband subscriptions per 100 inhabitants stood at 78.4 percent. The international Internet bandwidth per Internet user was at 62,650 bits.

Within the public sector, there are seven tertiary education institutions: the University of Mauritius (UoM), University of Technology, Mauritius (UTM), the Mahatma Gandhi Institute (MGI), the Rabindranath Tagore Institute (RTI), the Open University of Mauritius (OU), previously known as the Mauritius College of the Air, the Fashion and Design Institute (FDI) as well as the newly-created Université des Mascareignes (a merger of the former 2 polytechnics, namely the Swami Dayanand Institute of Management and the Institut Supérieur de Technologie). Three public institutions also run programmes at the tertiary level: the Mauritius Institute of Training and Development (MITD), the Mauritius Institute of Health (MIH) and the Mauritius Institute of Education (MIE). In addition to the seven institutions, 55 private institutions are registered locally, providing tertiary education in diverse fields, ranging from Certificate to PhD, with the awarding bodies mostly based overseas (52 out of 58).

10.2 ICT Background

Mauritius has emerged as an international and competitive ICT destination and is steadily positioning itself as a regional ICT Hub. The Government Programme 2010 - 2015 was to create an “i-Mauritius”, Intelligent Mauritius, making Mauritius one of the most connected nations in the world and to reduce the digital divide by providing access to broadband. The Government has developed

and implemented two National ICT Strategic Plans 2007 - 2011 and 2011 - 2014, which have developed the ICT sector. The Strategic ICT plan builds on five strategies categorised under five pillars:

- (i) Setting up Smart Cities and Techno parks across the Island
- (ii) Development of an ultra-high speed, safe and trusted telecommunications infrastructure.
- (iii) Building a Globally competitive workforce for Technology and Communication
- (iv) Development of a National Innovation Programme
- (v) Making Mauritius a Regional Hub and a gateway to Africa.

To foster innovation and develop a vibrant ICT Sector, the Ministry of Technology, Communication and Innovation (MTCI) has been set up in 2015 to replace the Ministry of Information Technology and Communication (MICT). The main objectives of the MTCI are to

- Formulate appropriate policies and provide the necessary legal framework for the development of ICT and its optimal use across all sectors.
- Facilitate, through the implementation of an E-Government programme, the provision of Government services electronically anytime anywhere for the greater convenience of the public.
- Promote and facilitate the development of the ICT sector.
- Ensure that the ICT culture permeates all levels of the society to bridge the digital divide to the extent possible.
- Promote the development of ICT enabled services including e-business.
- Encourage the adoption of new technologies and best practices in the ICT.
- Promote capacity building in ICT

Institutions reporting to MTCI include: the National Computer Board (NCB), the Mauritius Research Council (MRC), the ICT Authority (ICTA) and the -Data Protection Office (DPO). The core mission of the NCB is to accelerate the transition of Mauritius into a regional ICT hub and ensure the swift realisation of government's objective to make of the ICT sector a key pillar of the economy. MRC acts as a central body to advise Government on Science and Technology issues and to influence the direction of technological innovation by funding research projects in areas of national priority and encouraging strategic partnerships. The DPO aims to protect privacy rights of individuals. The ICT-BPO industry in Mauritius has experienced sustained growth from less than 100 companies in 2005 to 750 in 2016.

Major international ICT players, including Oracle, Microsoft, IBM, HP, CISCO, Orange Business Services, Accenture, Infosys, Hinduja Group, France Telecom, Ceridian, the TNT Group, have set up their operation and development centres in Mauritius.

There are two main ICT industry associations in Mauritius: the Mauritius IT Industry Association (MITIA) and the Outsourcing and Telecommunications Association of Mauritius (OTAM). MITIA is an

association of major ICT companies, whereas OTAM represents the interests of the Telecom operators and the BPO players in Mauritius.

The Government of Mauritius is fully conscious of the key role that the legal framework has to play in ensuring a healthy and sustainable development in the ICT industry. In this context, appropriate legislations on data security, protection of intellectual property rights and cyber crimes (Electronic Transaction Act, Computer Misuse and Cybercrime Act, Data Protection Act etc) have been enacted to encourage the effective growth of the ICT sector.

A National Broadband Policy 2012 – 2020 (NBP2012) was launched in January 2012, which sets out a strategic vision for a broadband Intelligent Mauritius, and establishes national goals regarding broadband while elaborating specific policies to achieve those goals within the overarching National ICT Strategic Plan (NICTSP) 2011-2014 context.

In May 2017, the government launched the National Open Data Policy. The purpose of this policy document is to formulate the appropriate guidelines and processes for Ministries and Departments in the release and management of Government datasets as open data. The Open Data Portal is operational with more than 100 datasets of various sectors (data.govmu.org). The portal allows Government agencies to publish non-sensitive datasets for use by the public and businesses to create data-driven applications or research. The portal will empower citizens and businesses to carry out data-driven initiatives such as development of mobile apps, data analysis, creation of innovative products and research.

Recognising the positive impact of e-Government on the development of the Republic of Mauritius, the Ministry of Technology, Communication and Innovation (MTCI) together with the Central Informatics Bureau embarked in the preparation of the Digital Government Transformation Strategy 2018-2022 (DGTS). Through harnessing opportunities for digital transformation in the public sector, the DGTS is aligned with, and goes hand-in-hand with the Public Sector Business Transformation Strategy (PSBTS) for achieving Government's Vision 2030. The DGTS provides Government with digital policies to attain all 17 UN Sustainable Development Goals (SDGs). It sets the course for accelerated public sector digitisation efforts to enhance operational effectiveness and efficiency, and better service to citizen, business and government constituents. It makes recommendations that culminate into better policies and services that are simple, smart and seamless. The DGTS advocates innovative concepts including Digital-by-Default Services, Once-Only Principle, E-Participation, Agile Principles etc. An action plan will also be drafted to accompany government agencies in the implementation of recommendations found in the DGTS.

Other relevant strategies include

- eGovernment Strategy (2013 - 2017) which outlines measures for Government2Business, Government2Citizen and Government2Government
- National Green IT Policy and Strategy (2014 - 2017)

- National Open Source Policy, Strategy and Action Plan (2014 - 2019)
- National Cyber Security Strategy (2014 - 2019)
- National eWaste Policy, Strategy and Action (2015)

10.3 Current ICT Initiatives and projects

ICT Initiatives are currently ongoing at national level in the areas of Education (Universal ICT Education Programme, Education through ICT, Digital Youth Engagement Programme), Digital Divide (Community Empowerment Programme, Public Internet Access Points, Cyber Caravan Project, Community Web Portal), eGovernment (Government Online Services and eServices, Mauritius National Identify Card, Public Key Infrastructure, eJudiciary Programme, Crime Occurrence Tracking System, ePayment Project, eHealth, ePrison, National ICT Strategic Plan, eGovernment Strategy Report, Mauritius e-Registry Project), Cyber Security (National Computer Emergency Response Team, Critical Information Infrastructure Framework, National Cyber Security Strategy), Entrepreneurship (NCB Technopreneur Unit), Green IT (National Green IT Policy and Strategy, eWaste Policy and Strategy) and Open Source Policy and Strategy.

10.3.1 Universal ICT Education Programme

The National Computer Board (NCB) operating under the aegis of the MTCI has been implementing the Universal ICT Education Programme (UIEP) since September 2006. One of the priorities of the programme is the introduction of the internationally acknowledged Internet and Computing Core Certification (IC3) course with a view of making it the benchmark for digital literacy/proficiency in Mauritius.

The programme aims at training a maximum number of persons comprising students, employees, non-employee and the population at large on the IC3 course in line with Government's vision of accelerating the transformation of Mauritius into an ICT hub and in developing ICT into a major pillar of the economy.

The IC3 course 45 hrs in duration and trainings are delivered in State Secondary Schools after school hours and during weekends using IT facilities that would have otherwise remained idle. To date 250,000 people have been trained on the IC3 programme.

10.3.2 Digital Youth Engagement Programme Project - Coding in Cyber Caravans

As announced in the Budget Speech 2017-2018, the National Computer Board (NCB), a parastatal body operating under the aegis of the Ministry of Technology, Communication and Innovation, is implementing the '**Digital Youth Engagement Programme (DYEP)**' which comprise the provision of introductory courses on Coding to youngsters. NCB is therefore reviewing the trainings provided in its Cyber Caravans into coding sessions which will be dispensed to students and the community.

The National Computer Board will act as a training service provider to the Ministry of Education for the introduction of Coding in primary schools starting as early as Grade 4 and Grade 5. The learners will be provided with a 15-hour training delivered in the Cyber Caravans, which will proceed to various primary schools around the island following a joint collaboration and an agreed timetable with the Ministry of Education and Human Resources, Tertiary Education and Scientific Research.

The objectives of introducing Coding at an early age are to:

- Spark the interest of our young learners for STEM (Science, Technology, Engineering, and Mathematics) subjects.
- Contribute to increase the number of students opting for Science and Computer Subjects at Secondary and Tertiary Levels.

A number of coding skills will be imparted to the students via course materials accessible online from an Open Source coding platform (Code.org). The skills to be taught include:

- Reinforcement of Pre-Requisites (Mouse Skills)
- Sequence
- Debugging codes
- Understanding and Devising of Algorithms
- Use of loops

It is expected that this initiative will, in the long run, contribute towards creating an adequate and diversified talent pool to fill the increasing number of technology jobs that shall be available in the future and hence drive the growth of the ICT Sector.

NCB will make use of a mix of IT equipment (in the Cyber Caravans) including PCs, Laptops, Raspberry Pi and Tablets for the delivery of the trainings in coding. It will be seamless for the learner accessing online course materials from whatever device he/she is using and at the same time this will also be an opportunity to showcase the latest IT technologies available to the students and community. To date c. 1,588 participants have undertaken the DYEP training

10.3.3 Community Empowerment Programme

The objective of the Community Empowerment Programme (CEP) is to facilitate the process for the community to make use of ICT to fully participate in the socio-economic development of Mauritius. The CEP is in line with the Government programme to encourage the development of local content and creativity. The CEP consists of the following projects:

1. Wi-Fi Mauritius

350 locations in public places in Mauritius have been equipped with free Wi-Fi hotspots with 10 MB Internet connection through Optical Fibre. The Wi-Fi access is being promoted by the 'bringing of one's own device' philosophy.

Previously, under the Community Empowerment Programme, the NCB had set up Computer Clubs on a regional basis to provide free access to ICT tools and Internet in collaboration with Microsoft and Mauritius Telecom Foundation with the aim to provide free access to ICT tools and Internet. The Wi-Fi locations have been chosen based on the existing sites of Computer Clubs, Public Internet Access Points (PIAPs), ZEP schools, etc and their existing lines have been used to provide Wi-Fi.

2. Setting up of Learning Corners in Rodrigues

The purpose of this project is to provide free access to ICT tools and Internet to Rodriguans. The Learning Corners add to the development of Rodrigues by facilitating the democratisation of ICTs in order to contribute in the empowerment of the community through the use of ICTs and free access to broadband Internet. It helps to provide information and communication infrastructure and promote ICT for educational, personal and social development by providing free Internet access.

Each Learning Corner is equipped with three computers and free Internet access and is open to the public.

11 Learning Corners have been set up in Rodrigues in the following locations in 2013: Citron Donis YC, Bigarade CC, Mon Plaisir CC, La Ferme CC, Latanier CC, Oyster Bay YC, English Bay CC, Grande Montagne YC, Centre Polivalent de Citronelle CC, Dans Bebe CC, Fond La Bonte CC.

An additional 10 Learning Corners have been set up in Rodrigues in August 2014 with the collaboration of the National Empowerment Foundation (NEF) and Mauritius Telecom Foundation (MTF) in the following Community Centres: Anse Goeland, Baie Topaze, Batatrand, Battue Madame, Deux Goyave, Mangue, Mt Charlot, Roche Bon Dieu, Tamarin and Vangard.

Some 38,000 users have benefitted from the facilities in the Learning Corners.

3. Public Internet Access Points (PIAPs)

In addition, access to ICT infrastructure and Internet has been accelerated by the set up of Public Internet Access Points (PIAPs) in the 95 post offices around the island. 5 PIAPs are also available in Rodrigues. This measure will result in a further increase in ICT and Internet penetration of Mauritian citizens. More than 315,000 registrations have been noted in the PIAPs.

10.3.4 Government Online Services (GOC) and e-Services

The Government Online Centre (GOC), operational since May 2005, is a centralised data centre that supports e-Government initiatives. The GOC hosts the Government Web Portal (GWP), which provides secured online Government services round-the-clock. Being a common platform for Ministries and Departments, the GOC enables the optimisation of IT investment for the public sector. Over 200 websites are being hosted for Ministries and Departments and Parastatal Bodies.

The Government Web Portal²⁹² (GWP) is a one-stop-shop providing comprehensive information and enabling online applications on a 24 x 7 x 365 basis in a user-friendly manner. The GWP consists of a homepage and four sub-portals, namely, Citizen, Government, Non-Citizen and Business.

The GWP has a dedicated **eServices** section for online applications. This eServices section enables the submission of online applications, the receipt of online acknowledgements and the online tracking of the status of applications, amongst others. The list of e-services have been segmented by target persons (105 services), by domain (50 services), by Ministry (40 services), by department (10 services) and by parastatal bodies (10 services). There has been an exponential growth of use of eServices for the past 10 years. Citizens can also transact with the Government through payment of online services, for instance, payment of a driving test or payment for police duties request. In addition, the government portal is now mobile friendly with the Smart App (over Apple and Android) and the Smart Browser View.

A key element in e-Government, the GOC offers web site publishing and hosting services and host common and back-office applications of Ministries and Departments such as the Registry System, Central Personnel Systems, Labour Market Information System, Environment Information System, Central Population Database amongst others.

GOC also provides Internet access to over 180 secondary schools and 265 primary schools and Internet & E-mail facilities to over 8,000 employees of Ministries and Departments, making the institution the 2nd largest Email Provider in Mauritius.

With the setting up of a National Internet Exchange Point (NIXP) on the GOC platform, Internet Service Providers (ISPs) in Mauritius can peer through to GOC so that local bandwidth is contained in Mauritius thereby saving on international bandwidth.

10.3.5 National Computer Emergency Response Team (CERT-MU)

The Computer Emergency Response Team of Mauritius (CERT-MU), a division of the National Computer Board, is promoting cyber security issues at the national level. CERT-MU serves as a focal point in Mauritius for computer security incident reporting and Response. Mauritius is placed 6th globally and first in Africa based on the ITU's Cyber Security Index.

Services offered by CERT-MU include:

- Information Security Incident Handling and Management
- Vulnerability scanning and Penetration Testing of networks, applications, and devices
- Disseminating information security news and latest information security alerts to constituency members
- Advise parents on the issues of Child Online Safety including Social Networking sites

²⁹² <http://www.gov.mu/>

- Security Awareness Programmes on Information Security
- Third Party Auditing and providing assistance in implementing ISO 27001.

CERT-MU is also a member of the following bodies:

1. Forum for Incident Response and Security Teams (FIRST), a premier organisation and recognised global leader in incident response.
2. Anti- Phishing Working Group (APWG)
3. International Multilateral Partnership Against Cyber Threats (IMPACT)
4. Cyber Security Alliance for Mutual Progress (CAMP) – South Korea

10.3.6 National CyberCrime Strategy

A National Cybercrime Strategy has been developed and approved by the Government on 25th August 2017. The objective of the strategy is to enhance the law enforcement capacity and strengthen the legal framework in order to combat cybercrime effectively. This strategy is being implemented.

10.3.7 NCB Technopreneurship Unit

In line with the Government vision on establishing a Techno-entrepreneurship culture to build an innovative ICT Start-up Nation, the National Computer Board (NCB) re-engineered its ICT Incubator Centre into the Technopreneurship unit. The Technopreneurship Unit is a key player in promoting Entrepreneurship in the ICT Sector.

The main objectives of the Technopreneurship Unit of NCB are to:

- Create a Techno-entrepreneurship culture to build an innovative ICT Start-up Nation
- Encourage Ideation, Innovation, Creativity and Entrepreneurship to develop ICT Start-ups and Technopreneurs
- Organise Program and initiatives in emerging Technologies to develop a Community of Entrepreneurs in ICT Sector
- Promote and Inspire start-ups to come up with Innovative solutions/ services to improve life of Citizen through the use of ICT.

The Technopreneurship Unit organises *TechideaSpace* to help nascent, university students, fresh graduates, undergraduates, young IT and ITES Professionals, postgraduates, researchers, academics, secondary students and aspiring ICT start-ups with new innovative/ creative ideas to Turn Idea to Business. The Unit also act as Facilitator / Mentor to start-ups in realizing their projects.

Moreover assistance are provided to start-ups in preparing their Business Model, in writing Business Plan, in preparing financial forecasts and in preparing Marketing plan. Software start-ups have access to Microsoft development Tools through the BizSpark Program. Start-ups are not only

guided on how to start business in the ICT sector and how to incorporate their company but they are also guided about the different financing schemes available for funding ICT projects in Mauritius.

To attract and encourage the innovative minds of Mauritius new generation by challenging their creativity and capacity in Business, Science and Technology, the National Computer Board organises the ICT Innovative Business Idea Competition. This Competition welcomes business ideas related to Information, Communication & Technology (ICT) focusing particularly in development of tools that will improve lives by making it easier for citizens to receive innovative services/ solutions to improve access to smart services through the use of technology. To promote the culture of Innovation among the University Students, the 2017- 2018 edition of this Competition is being organised for University Students.

To encourage the community of Technopreneurs to meet, share ideas, learn new schemes/skills and discover growing opportunities in the latest technologies, the Technopreneurship Unit organises Tech talks.

10.3.8 E-Government Projects

In line with the eGovernment Strategy 2013 - 2017, a number of eGovernment projects have been implemented:

(a) Law and Order - Crime Occurrence Tracking System (COTS)

In November 2012 the Crime Occurrence Tracking System (COTS) was implemented on a pilot basis to empower MPF with a tool for effective and efficient tracking of crime occurrences in the country using emerging ICT solutions. The system encompasses Computerisation of Occurrence Book & Master Registers, Tracking of movement of case file or dossier, Generation of Statistical Information and Maintenance of confidentiality.

With COTS in place, statements are captured electronically at Police Stations, finding of enquiries captured online and cases lodged at Courts are stored in the system. This ensures that case related information is easily available and supports closer monitoring of crime cases and statistics.

(b) e-Prison: The e-Prison system was launched in May 2014 for a better management of the prison inmates and a follow-up on their rehabilitation. Phase II of the system consists of an enhancement of the existing system to cater for the additional modules such as Prison Staff Intelligence Gathering System, duty management information system etc. The ePrison system will also be extended to other stakeholders (Rodrigues Prison, Correctional Youth Centre for Girls, Crime Record Office etc.)

(c) e-Judiciary - In April 2013, an e-Filing System has been implemented at the Commercial Court for commercial cases. The next stage will be the roll out of the solution to other courts including district courts for the trial of criminal cases.

- (d) e-Procurement: The Ministry of Finance and Economic Development (MOFED) has implemented an integrated web-based e-Procurement System (ePS) for the Public Sector that will improve procurement processes and enhance transparency.
- (e) e-Work Permit: The processing of work permits is presently witnessing a major transformation with the advent of technology. This system aims to facilitate the application and issuing of work permits within 2 weeks.
- (f) e-Education: Government has significantly progressed on its e-Education journey. Classroom teaching and learning has been revolutionized with the introduction of interactive projectors in primary schools through the Sankore project. Now Government has initiated the next stage of the e-Education revolution through the distribution of tablets to primary school students of Grades I and 2 in Mauritius, Rodrigues and Agalega. Government will further extend this project by providing tablets to Grade 3 students. Pupils will learn from their teachers, from their peers as well as from the vast ocean of knowledge available on the web. The classrooms are also undergoing a major uplifting through the provision of Wi-Fi connectivity and high bandwidth Internet to primary and secondary Schools.

SchoolNet II - Deployment of Internet links and wireless connectivity in more than 150 sites in Mauritius and Rodrigues comprising Secondary State Schools, Grant-aided Secondary Schools, and Public Libraries among others will be completed by November 2017.

Tablet Computers for Grade I, II students and educators - To support the Early Digital Learning Programme and to modernise teaching and learning through the use of ICT tools. Distribution of Tablet Computers will start as from October 2017.

- (g) eHealth: Work is ongoing to implement an eHealth system including electronic medical records, electronic imaging systems and ePrescriptions
- (h) e-Payment project: The ePayment system is operational since November 2013 in the Government Online Centre supporting payment for more than 10 services including driving license and police fees, for Lease of state land, for Incorporation of a business, company registration fees and parking fines

Mauritius e-Registry Project (Online Registration of Deeds): Provide integrated workflows and options for businesses, professionals and members of the public to conduct business with the Registrar General Department over the Internet. MeRP allows for e-Submission of documents, e-Payment of duties and taxes, e Registration and e-Delivery of registered documents.

- (i) Info Highway System: Government has implemented the Info Highway System, which provides for sharing of data amongst Government agencies. Its objective is to provide a robust service platform to facilitate the consumption of published data amongst Government agencies to improve operation efficiency in public administration and business operations. It also aims at establishing links to other Ministries/Departments and institutions. The InfoHighway project has been recognized as a WSIS Prizes 2018 champion in the 'category 7 E-government' by

the International Telecommunication Union (ITU) at the World Summit on the Information Society (WSIS) Prizes 2018 Ceremony.

- (j) Electronic Document Management System (eDMS): eDMS has been implemented to enable the electronic storage and retrieval of files in Ministries and Departments. It has been implemented on a pilot basis at the Ministry of Technology, Communication and Innovation and at the Ministry of Finance and Economic Development. The eDMS would also act as a repository of digitally signed documents and emails. The system will allow Government agencies to effectively manage large volume of existing and future anticipated documents and to streamline the flow of data across the government agencies. The system is paving the way towards a paperless Government, better flow of information and better service delivery.
- (k) e-Recruitment : The e-Recruitment system allows applicants to apply for vacancies advertised by the Public Service Commission (PSC) through an online application form. The system provides for the determination of eligibility and non-eligibility of the candidates and generates a list of eligible candidate after the closing date.
- (l) Building & Land Use Permit (BLP) System: The system allows online application submission and processing for the different types of Building & Land Use Permits for any of the 12 Local Authorities. The BLP e-service now also includes online payment of relevant BLP Fees.
- (m) Cooperatives Division e-Registration Project (CDeRP): The CDeRP System allows online applications for registration for new cooperatives, online payment facilities for existing and new cooperatives, and online submission of accounts of cooperatives to facilitate audits. Supporting documents in electronic format are also submitted online to the Ministry of Business, Enterprise and Cooperatives through the Portal.
- (n) Domestic Violence Information System (DOVIS) : The DOVIS provides the Ministry of Gender Equality, Child Development and Family Welfare with a tool that facilitates the management of domestic violence cases in order to better control cases of domestic violence. The system aims to decrease the incidence of cases of domestic violence and to provide assistance and protection to victims of domestic violence and rehabilitation of perpetrators.

10.3.9 Smart Mobile Apps

In line with the Vision 2030, The Government has embarked on the implementation of 10 mobile apps, a Government apps directory and a mobile app platform. Seven mobile apps have been completed and are available for download to the Public:

- Smart Police
- Smart Traffic
- Consumer Rights
- Search Gov
- Emergency Alert
- Family Welfare

- School Companion

10.3.10 Critical Information Infrastructure Framework

The project aims at setting up a policy framework for Information Security Assurance and Critical Information Infrastructure Protection with the main objective of identifying and protecting the critical information infrastructures of Mauritius. The policy will be based on the UN Resolution 58/199: Creating a Global Culture of Cybersecurity and Protection of Critical Information Infrastructures and focuses on leadership, risk mitigation and awareness and defines a plan of immediate actions to strengthen the security and resilience of CIIs. The main critical sectors identified for Mauritius are namely Energy, Financial Services (incl. Banking), Government Services, Health, ICT & Broadcasting, Manufacturing, Sugar, Transport & Logistics, Tourism, Customs and Water Supply. The main recommendations for the policy fall under 3 main pillars:-

- Leadership and Governance: Establish clear leadership and governance in information security risk management at national level and at level of organizations;
- Risk Mitigation: Establish mandatory information security risk management policy for critical sector operators to protect against cyber security threats.
- Awareness and Prevention: Promote the adoption of information security best practices.

The project forms part of the National CyberSecurity Strategy and Action Plan 2014 - 2019.

10.3.11 EU Code of Conduct for Data Centres

In line with its initiatives to promote Green IT, the NCB organised a capacity building programme on EU Code of Conduct for Data Centres (EUCOC) in 2013, leading to industry certification from BCS, the Chartered Institute for IT, with 60 participants from organisations operating data centres or large server rooms. The EUCOC is a series of best practices that have been created by the UK's Department for the Environment, Farming and Rural affairs (DEFRA), the British Computer Society Data Centre specialist group (BCS DCSG) and the EU Joint Research Centre (EU-JRC) in conjunction with industry professionals for use in mission critical data centres/server room environments. They provide mechanisms for ICT staff to implement energy efficiency measures to reduce energy consumption, thus reducing GHG emission and associated reduction in energy costs. This capacity building programme was funded by the European Union and a Report has been prepared by the Consultant with the main objective of providing recommendations and measures to enhance energy efficient data centres in Mauritius.

The NCB has been granted an "Endorser" of the EUCOC, being the first organisation in the African Region, with the main aim of promoting the code for data centres in Mauritius.

10.3.12 Implementation of Anti-Cyber Threat Monitoring System

The Cyber Threat Monitoring System will enable CERT to better respond, monitor and coordinate cyber-threats at the national level. The system will have the capability for early detection of

potentially devastating cyber-attacks and the ability to respond to cyber security incidents in real time. Through this establishment, cyber threats can be monitored round-the-clock for critical installations.

The core functions of the system are to:

- Reduce the risk of cyber security threats and attacks on government websites and portals, as well as critical information infrastructures.
- Carry out round-the-clock security operations for early detection and prevention of potential cyber threats.
- Gather cyber threat intelligence, which it will analyse and assess for drawing up defensive measures at the national level.
- Promote awareness of cyber threats and coordinate security responses in both public and private sectors.

The other core activity of the Anti-Cyber Threat Monitoring System is the Cyber Threat Analysis. This will help to mitigate cyber risk with a comprehensive approach to threat identification, intelligence gathering and validation, and response to protect critical information of the constituency members. This will also help to determine the nature of attacks, vulnerability types and analysis of malicious code.

10.3.13 NOSECC to promote Open Source

The National Computer Board has developed a National Open Source Policy and Strategy that was approved by Cabinet in 2014 and following Cabinet Decisions of 2015, it was mentioned that the National Open Source Competency and Excellence Centre will be set up under the aegis of the National Computer Board.

NOSECC represents primarily a coordinating framework for all stakeholders and a guidance in the direction of the OSS Policy, so their roles and activities may be different and numerous. The following list outlines some, but not all of them:

- coordination between stakeholders
- implementing OSS policy, OSS strategy, OSS action plan
- main contact in GOV for OSS issues (regulation, strategies, execution)
- create and publish OSS technologies/Solutions/service government plan for short / medium term
- support government users in choosing, planning and using OSS
- to influence and collaborate in procurement system changes
- assist in preparing RfPs and tenders for ICT procurement
- Open Summit Mauritius organisation/coordination

- creating sub documents (guidelines, standards, interoperability framework, SW/technologies select process, SW repository editorial)

10.3.14 Mauritian Cubesat

A dedicated team led by the Mauritius Research Council, in consultation with the University of Mauritius, University of Technology, Mauritius, Mauritius Sugar Industry Research Institute and the Mauritius Oceanography Institute, drafted an explicit technical document for the design of the first Mauritian CubeSat. The MRC team also benefited from international collaborators with expertise in relevant fields including Clyde Space (UK); TeleSpazio (France) and ASTOS Solutions (Germany). The proposed satellite will be equipped with an infrared thermal imaging camera, which will provide detailed spatial and temporal data for land and ocean studies of Mauritius. The nanosatellite will also be used as a test platform to test inter-island connectivity by broadcasting updates to remote islands of the Republic of Mauritius. Positive results from the CubeSat experiment could lead to the development of a large scale solution for inter-island communication. The satellite will be launched in 2019.

10.3.15 Setting up of a Centre of Excellence on Cybersecurity and Cybercrime in Mauritius

The Ministry of Technology, Communication and Innovation is setting up a Centre of Excellence on Cybersecurity and Cybercrime in Mauritius to address the main challenges facing the country namely, the harmonisation of cybercrime policy and legislative frameworks; fostering of international co-operation through promotion of information sharing; how to address rapid advances in the deployment of new technologies to fight cybercrime; mapping legal and regulatory instruments with existing regional and international best practices and capacity building for technical managerial expertise and knowhow to address cybercrime as well as sensitization of the general public, and law enforcement agencies. The centre will serve as a common platform to discuss how law enforcement agencies could detect, handle and prosecute cybercriminals and the judiciary to understand this highly technical and complex area whenever cases are brought before Courts. The role of the Centre to address cybercrime will be to set out the right approach to fight cybercrime through improved cyber threat intelligence and law enforcement capability, effective criminal justice framework and active international engagement.

10.4 National ICT Research Capacity and Priorities for Cooperation

10.4.1 National Priorities

National ICT Research Priorities include ICT Energy Efficiency, eWaste Management, eAgriculture, Bio-informatics, Biometric Security, Context Awareness, eHealth, Technology-enhanced Learning, Digital Enterprise.

- ICT Energy Efficiency – Focused on reducing carbon emissions, Minimising environmental impacts and sustainable economic development. Institutions involved include: University of

Mauritius, National Computer Board, University Technology Mauritius and Mauritius Research Council, Middlesex University

- eWaste Management – Focused on minimising environmental impact, promoting standards linked with eWaste reduction and promoting a Green and sustainable environment. Institutions involved include: University of Mauritius, University Technology Mauritius, Ministry of Local Government and National Computer Board
- Software Engineering – Focused on boosting the Software industry, creating skilled software developers and branding Mauritius as ICT Hub. Institutions involved include: University Technology Mauritius, University of Mauritius, Université des Mascareignes and National Computer Board
- Bio-Informatics – Focused on improving the health of the population. Institutions involved include: University Technology Mauritius
- Biometric Security – Focused on security identification of the individual. Institutions involved include University of Mauritius
- Intrusion Forensic – Focused on Security and Confidentiality. Institutions involved include University Technology Mauritius, Université des Mascareignes
- Attack on VOIP Networks – Focused on Security and Denial of Service. Institutions involved include University Technology Mauritius
- Context Awareness – Focused on improving the lives of society and improving healthcare services. Institutions involved include University of Mauritius, Université des Mascareignes
- Performance optimisation of database driven websites – Focused on boosting the software industry and creating skills software developers. Institutions involved include University Technology Mauritius, Université des Mascareignes
- ICT for Creativity and Productivity – Focused on improving the productivity of the individual and organisation. Institutions involved include: University Technology Mauritius and University of Mauritius
- ICT for Health – Focused on improvement of healthcare service. Institutions involved include: University Technology Mauritius, Université des Mascareignes and University of Mauritius
- Technology-enhanced Learning – Focused on promoting eLearning and eEducation. Institutions involved include: University of Mauritius, University des Miscarriages and Mauritius Research Council
- Digital Enterprise – Focused on Multimedia development leading to sustainable and green environment. Institutions involved include: University Technology Mauritius
- Scientific Computing - GPU Computing with iterative solutions methods. Institutions involved include: University Technology Mauritius
- Big Data Technologies - University of technology Mauritius, Middlesex University

10.4.2 National Research Capacity

The table below provides an overview of universities in Mauritius with ICT/Engineering Courses for 2017/2018:

Institution (Publicly funded)	Location	Total Students		Undergraduate Students		Post-Graduate (Masters, PhD)	
		Overall	ICT/Eng	Overall	ICT/Eng	Overall	ICT/Eng
University of Mauritius	Reduit	9,671	2,324	9,108	2,181	563	143
University of Technology	Pointes-aux-Sable	3,291	819	2,696	652	595	167
Open University of Mauritius	Reduit	3,578	245	2,460	245	1,118	-
Universite des Mascareignes (ex- Swami Dayanand Institute of Management and Institute Superieure)	Beau Plan	866	531	852	525	14	6
Mauritius Institute of Training Development	Phoenix	516	215	256	215	260	-
Fashion and Design Institute	Ebene	250	75	250	75		

Institution (Private)	Location	Total Students		Undergraduate Students		Post-Graduate (Masters, PhD)	
		Overall	ICT/Eng	Overall	ICT/Eng	Overall	ICT/Eng
Aberystwyth University (Mauritius Branch)	Flic-en Flac	49	9	46	9	3	-
African Leadership University	Pamplemousses	278	126	278	126	-	-
Atlantis Business School	Vacoas	17	17	17	17	-	-
Charles Telfair Institute	Quatres-Bornes	1,492	264	1,436	264	62	-
Middlesex University (Mauritius Branch)	Ebene	743	153	533	116	190	37
PTC Training Centre	Rose Hill	46	3	28	-	18	3
Rushmore Ltd	Quatres-Bornes	267	69	229	69	38	-
Talent Solutions Ltd	Pierrefonds	163	73	132	73	31	-
The Executive Business and Computational Institute	Quatres-Bornes	32	21	28	21	4	-
UOM Trust	Reduit	237	24	225	19	12	5
Whitefield Business School	Quatres-Bornes	300	150	300	150	-	-

Note: Overall ICT/Eng also includes Certificates, Diplomas, Undergraduates, and Post Graduates

Source: Tertiary Education Commission (2018)

The following universities and research centres in Mauritius are undertaking ICT-related initiatives in the research field. As part of its ongoing IST-Africa activities, National Computer Board has undertaken a consultation with national stakeholders and each institute has outlined its current research expertise, track record and mapping to research areas:

➤ **University of Mauritius²⁹³**

- Department Computer Science and Engineering; Department Mechanical and Production Engineering; Department of Chemical & Environmental Engineering
- Research areas include: Health; Climate; Environment; Smart Cities; Bio-informatics; Efficient Computing; IPV6; Context Awareness; Mobile and Ubiquitous Computing; Smart Energy Grid; Energy engineering and management; Renewable energy technologies; Biometric Security; Access Control for healthcare; Software agents; Software oriented Services; Metadata development; Ontology engineering; Adaptive Coding Techniques for Data Transmission, Growth of Nanostructured Materials; Intelligent/Computational Intelligent Systems: Neural Networks; Fuzzy and Immune Systems, Quantum Computing; Computational Intelligence, Human-Computer Interaction; Sustainable Agriculture & Bio-Economy; Energy engineering and management; Renewable energy technologies



Examples of research expertise and types of projects undertaken are provided below:

Faculty of Information, Communication and Digital Technologies

The Faculty was created in March 2017 from the previous Department of Computer Science and Engineering and consists of three departments (Digital Technologies, Information and Communication Technologies and Software and Information Systems). It consists of the following research groups:

- **Computational Biology and Bioinformatics** The objectives of this group are to study algorithms used in Bioinformatics, to contribute new algorithms, to study how Bioinformatics data is stored and accessed throughout the world, and to look into how Mauritius can contribute to Bioinformatics Data Banks. Projects undertaken by this research group include:
 - Setting up a Data Warehouse for Infectious Diseases (2013-2014, Internally Funded by University of Mauritius)
 - A Support Framework to Optimize Access to Remote Bioinformatics Data (2014-2015, Internally Funded by University of Mauritius)

²⁹³ <http://www.uom.ac.mu>

- Discovering relationships between diseases and genes using the human structural interactome and biological pathways (2016-2021, Funded by Mauritius Research Council)
- Computational Analysis for Understanding Evolution of Infectious Diseases (2016-2018, Funded by Mauritius Research Council)
- A systematic identification and analysis of disease-related modules in the human protein-protein interaction network (2016-2017, Funded by Mauritius Research Council)
- Computational Methods for the Functional Annotation of Hypothetical Proteins in Infectious Diseases (2017-2018, Funded by Mauritius Research Council)
- H3ABioNet (Goal: To develop a Pan African Bioinformatics Network to support H3Africa research projects through the development of bioinformatics capacity on the continent, 2011-2017, Funded by NIH)
- NIH funded Research project (Grant Number: 2U24HG006941-06 FAIN: U24HG006941) "H3ABioNet: informatics solutions for H3Africa". Main PI: Prof. Nicola Mulder of the University of Cape Town. (2017-2022)
- A systematic identification and analysis of disease-related modules in the human protein-protein interaction network (2016, Funded by Mauritius Research Council).
- Bridging Bio-Medical Research and ICT in Mauritius – Creating Awareness (2017-2018, Funded by the Mauritius Research Council).
- *Computational Pan-genomics (2017-2019), under an RCA with Prof. Christos Ouzounis, Director of the Biological Computation & Process Laboratory at CPERI-CERTH*
- *Exploration of existing approaches and assessment of new method/s for the analysis of cancer pan-genomes (2018 - 2019, UoM Funded)*
- *Pole of Innovation in Health (2018-2021, Funded by MRC) along with CBBR and other partners; led by Assoc. Prof. Archana Bhaw-Luximon of CBBR.*

• **Efficient Computing**

The main aim of the research group is to propose computer-based solutions that improve the productivity of the individual and, consequently, improve the effectiveness of the organisation the individual belongs to. The current activities are:

- Consultancy for Aapravasii Ghat Trust fund (Aapravasii Ghat is a UNESCO world heritage centre)
- Proposal for EDP in Leveraging Web 2.0 in Mauritian Enterprises

• **Context awareness**

Context-Awareness is an emerging area of Computer Science, whereby computer systems can make decisions and take actions based on context information such as location, time temperature or the presence of specific individuals. The objective of this group is to investigate how the use of context-awareness can improve the lives of users and how

context-awareness can be put to the service of the Mauritian society. The University of Mauritius is working on a paper entitled “Access Control Mechanisms for Collaborative Context-Aware HealthCare Services in Mauritius”.

- **Health Informatics**

The objectives of this group is to apply Information Technology to various types of challenges in the Healthcare system to help better manage healthcare data as well as a support for improved health of patients. Projects undertaken include:

- An Access Control Mechanisms for Collaborative Context-Aware HealthCare Services in Mauritius (2010-2013, Funded by Mauritius Research Council).
- A Mobile System Framework to Support the Autonomous Self-management of Pre-Diabetes and Type 2 Diabetes Patients in Mauritius (2017-2018, Internally funded by the University of Mauritius).
- Data Analytics for Real-Time Disease Outbreak Management and Surveillance in Mauritius, Funded by the Mauritius Research Council, Principal Investigator (2017 – 2018, Funded by the Mauritius Research Council).

- **Intelligent systems**

The group concentrates on research in fields such as Biometrics, Computer Vision, Artificial intelligence and Human Computer Interaction

- Automatic Suspect Behaviour Recognition System (2013)
- Scalable Video Surveillance System for Suspect Behavior (2014)

- **Mobile and Ubiquitous Computing**

The main objective of this research group is to use these technologies to enhance the quality of life of human beings. The research group will investigate the human, social, technical, hardware and software issues involved with mobile and ubiquitous computing. Research projects in different areas including infrastructure development, identifying new concepts and building ubiquitous applications will be undertaken. The group will also address the issue of expert human resource development in this area.

- A mass media communication system using mobile voice technology for information dissemination during crisis situation in Mauritius (2016-2017, funded by Mauritius Research Council).
- An Audio Learning System over mobile phone for empowerment of Mauritian Farmers (2017-2018, Funded by Mauritius Research Council).

- **Biometrics**

- Development of A Framework for the Setting Up of Secure Biometric Data Storage In Mauritius (2016-2018, Funded by Mauritius Research Council)
- Pose and light invariant Face and Ear Recognition System.
- Building a Biometric Database of Palmar and Dorsal Hand Patterns A number of individual projects have also been undertaken and they are listed below under different research themes.

- **Wireless Sensor Networks**

- Optimal Wireless Sensor Network Topologies for Urban Drainage Monitoring System in Smart Cities, Funded by the Mauritius Research Council (2017 – 2018, Funded by Mauritius Research Council)
- Wireless Sensor Network System for Precision Agriculture (2012-2013, Internally Funded by University of Mauritius)
- Prototype Implementation of a Marine Information System using Sensor Networks and GIS (2014-2015, Internally Funded by University of Mauritius)
- Assets Tracking System using RFID Technology, (2008-2009, Internally Funded by the University of Mauritius)
- Modelling and Simulation of an Inland Tsunami Prediction System using Wireless Sensor Networks, (2014-2015, Internally Funded by the University of Mauritius)

- **Social Impact of ICT**

- A Study of Online Social Networks (OSNs) in Mauritius: Impact on Secondary Education (2011-2013, Funded by Mauritius Research Council).
- Investigating the factors Affecting technology acceptance in Mauritian SMEs.
- An ICT architecture for Smart Towns in Mauritius.
- Investigate & Forecast the Future Energy Demand and the Potential of Renewable Energy to Mitigate GHG Emissions (2011-2012)
- Study of Waste Collection Systems in two Local Authorities
- Development of an open platform for "Volunteer thinking" (2012-

- **Marine Information Management**

- An Ocean Data Management System (2016-2017, Funded by Mauritius Research Council).

- **Operating Systems**

- Implementation and Evaluation of ECNAS - Erasure Coded Network Attached Storage (NAS) (2014-2015, Internally Funded by University of Mauritius).

- **Green-Computing**

- A Sustainable Green-Computing Framework for Clusters of ICT Equipment (2013)

Department of Chemical & Environmental Engineering

Research projects include:

- Cane Resources Network for Southern Africa, 2002-2008²⁹⁴ - Funded by DG Research this network assessed the role of bio-energy from sugarcane in promoting sustainable development and improving global competitiveness in the region of southern Africa.
- Collaborative Curriculum Development on Waste Management in Africa and the Pacific Region (CODWAP), 2008-2011²⁹⁵ Funded by ACP, CODWSAP established an active and sustainable co-operation forum on curriculum development, which is consistent with African and Pacific Region socio-economic development priorities to develop Solid Waste Management educational tools including a Masters Course and training courses.
- Small Developing Island Renewable Energy Knowledge and Technology Transfer Network (DIREKT), 2009-2012²⁹⁶ - Funded by ACP S&T Program this project scheme involved universities from Germany, Fiji, Mauritius, Barbados and Trinidad & Tobago and focused on strengthening the science and technology capacity in the field of renewable energy of a sample of ACP (Africa, Caribbean, Pacific) small island developing states, by means of technology transfer, information exchange and networking
- Re-Resources Network, 2012-2017 focused on Solid waste Management in Western African countries.
- L3EAP²⁹⁷, 2013 - 2016 - This project was coordinated by Hamburg University of Applied Sciences in partnership with USP, University of Mauritius and Papua New Guinea University of Technology. It focused on increasing the capacity of universities in African, Caribbean and Pacific Group of States (ACP) SIDS to deliver high-quality Lifelong Learning courses on the topics of energy access, security and efficiency.

➤ **University of Technology, Mauritius²⁹⁸**

- Depts include: School of Innovation, Technology and Engineering; School of Sustainable Development and Tourism
- Research areas include: Climate change; Energy Management; Waste Management; Sustainable assessment; Future Internet; Mobile Communication; Context Awareness; IPV6; Data Mining; Web Caching Algorithms; Krylov subspace method for eigenvalue problem and its applications; Intrusion forensics; Security on SIP-based VoIP networks; Energy modelling for sensor networks; GPU Computing with iterative solution methods; Performance optimization of database-driven websites; Orange Money API

Examples of research expertise and types of projects undertaken are provided below:

²⁹⁴ <http://www.carensa.com/>

²⁹⁵ <http://acp-edulink.eu/content/codwap-collaborative-curriculum-development-waste-management-africa-and-pacific-region-0/>

²⁹⁶ <http://www.direkt-project.eu/>

²⁹⁷ <http://project-l3eap.eu/>

²⁹⁸ <http://www.utm.ac.mu>

- Implementation of a USSD API for Emerginov platform (2011)
- Digital Propagation models for Mauritius (completed)
- A technology independent framework for partitioning and retracting context awareness for next generation applications (2012 - 2013)
- Formulation of a unified data mining theory through composite functions (2004 - 2012)
- Web caching algorithms for highly customizable portals (2007 - 2012)
- ERP for SMEs (2008 - 2014)
- Learning difficulties in geometry (2008 - 2012) - investigated the performance of upper primary pupils in two-dimensional geometry
- Secure access through authentication and biometrics/smart cards technologies (2012 - 2015)
- GPU Computing with iterative solution methods (2012 - 2015)
- Reliability assessments and predictions over mobile and ubiquitous computing (2011 - 2015)
- Intrusion forensics - focused on providing a solution to code/data confidentiality of mobile agent based on an adapted implementation of the Bell-Lapadula model for access control. (2005 -)
- Security framework to combat attacks On SIP-based VoIP networks (2011 - 2017)
- Harnessing the potential of ICT to influence learning of mathematics in lower form at secondary level (2012 - 2017)
- Krylov subspace method for eigenvalue problem and its applications (2012 - 2016)
- Energy modelling for sensor networks (2008 - 2015)
- Software tool for option pricing (2008 - 2015)
- Performance optimization of database-driven websites using HTML5 web storage capabilities to model client side query caching mechanism (2012 - 2016)
- Orange Money API - Extension of Orange Money API from Orange France Telecom, to provide enhanced services to micro service developers.
- Open Hardware and Micro-Services - prototype to allow users with basic or no knowledge of C/C++ to use and access arduino remotely through a secure web API (2012 - 2013)
- Discrete-time Sylvester Matrix equations with fuzzy parameters (2013 - 2020, part time basis)
- Numerical algorithm to price life insurance and annuities (2013 - 2020, part time basis)
- 3D Compression for multimedia systems using mobile networks (2013 - 2020, part time basis)
- Feasibility Study for implementing IPv6 in Cellular Networks (completed)
- Triple Play Services on Power Line Communication (ongoing)

- Scaling Up IoT and M2M with IPv6
- Energy Information Systems with Agile Techniques (ongoing)
- Predictive Analysis using Time and Space Series for Carbon Footprint in Mauritius using a smartphone and sensors to predict acidity of seawater and other environmental indicators (ongoing)
- Transition models from traditional to SDN networks (ongoing)
- Optimal Harvesting Strategies for Fisheries (ongoing)
- High order methods for solving option pricing problem (2014 - 2021, part time basis)
- Citizen empowerment in newly born Smart Cities in Mauritius - focused on predicting behavioural intention to use smart city technologies use the TAM to effectively assess the perception and readiness and the perceived usefulness of certain smart city technologies such as for transportation as well as identifying key smart city applications for Mauritius.

➤ **Mauritius Research Council²⁹⁹**

- Research areas include: Wind turbine Technology; Technology-Enhanced Learning; IPV6

Examples of the types of research projects undertaken are provided below:

- Adaptive Coding Techniques for Time Varying Channels
- Developing successful entry strategies for BPO operations in Mauritius (completed)
- Electronic Commerce tools and Methodology using web-based technologies (completed)
- Evaluation of importance of corporate e-learning in providing a competitive edge to Mauritian companies (completed)
- A Study of Online Social Networks in Mauritius: Impact on Secondary Education (undertaken with University of Mauritius)
- A Secure data access model for the Mauritian Healthcare Services (undertaken with University of Mauritius) (completed 2012)
- Development of a Locally Designed Wind turbine Technology (completed)
- Supporting QoS in Mobile IPv6 Systems (2009 - ongoing)
- Development of a high-performance GPU- Based platform for application in Radio Astronomy and Climate Simulation Research (2015 - ongoing)
- A mass media communication system using mobile voice technology for information dissemination during crisis situation in Mauritius (2015 - ongoing)
- Optimal wireless sensor Network Topologies for Urban Drainage Monitoring System (2016 - ongoing)

²⁹⁹ <http://www.mrc.org.mu/>

- Development of an Interactive Mobile-based personal Carbon Footprint Calculator specific to Mauritius (2016 - ongoing)
- An ICT Architecture for small towns in Mauritius (2016 - ongoing)
- ICT framework for small and medium enterprises in Mauritius and Rodrigues: The enabler to growth, competitiveness and development (2016 - ongoing)
- Smart Irrigation System with Robotized Sprinkler (SISROS) (2016 - ongoing)
- TangiBooks- Interactive book series for primary schools with the integration of Augmented Reality (2016 - ongoing)
- Promoting Digital Literacy for Adoption of E - banking Services: A Strategy to Empower Women Entrepreneurs in Mauritius (2017 - ongoing)
- Mauhazard: An Interactive Tool to assess Hazard Perception Skills of drivers in Mauritius (2017 - ongoing)
- The Use of Digital and Social Media Marketing by Small and Medium Enterprises (SMEs) in Mauritius (2017 - ongoing)
- An Audio Based Mobile Learning System using the Interactive Voice Response (IVR) technology to empower Mauritian Farmers (2017 - ongoing)
- Evaluating the potential of crowdsensing for intelligent transport systems in Mauritius (2017 - ongoing)
- A pedagogical English Language software for pre-primary students (2016 - ongoing)
- Factors influencing the adoption of eGovernment services in Mauritius
- Factors affecting performances of first year students in online courses (completed)

➤ **Open University of Mauritius³⁰⁰**

- Research areas include: Simulation Software, Cloud Computing, Software and Services, Multimedia, Content Access and Analytics, Data Mining, Cognitive Systems, Advanced Interfaces, eHealth, Integrated Care, Technology-enhanced Learning, eGovernment Services, Big Data, Digital inclusion, Social innovation platforms, cybersecurity

Examples of research expertise and types of projects undertaken are provided below:

- Investigating the effective use of tablets by distance education learners (completed)

➤ **Charles Telfair Institute³⁰¹**

- Depts include Faculty of IT
- Research areas include: Green ICT, Digital Divide, Technology-enhanced Learning, IT Governance, Digital Inequality, Cloud Computing

³⁰⁰ <http://www.open.ac.mu>

³⁰¹ <http://www.telfair.ac.mu>

Examples of types of research projects undertaken are provided below:

- Development and Evaluation of IT Governance and Green IT Model to Support Large Mauritian Organisations
- Digital Inequality: The Internet in Mauritius (completed)
- Developing robust businesses with the power of cloud computing Among SMEs
- Social Media Marketing: An investigation into SME practices in Mauritius; a case study approach
- “Participatory culture and education: A roadmap to the integration of participatory culture in the curriculum”
- Are online tertiary courses a major threat to tertiary institutions? Evaluation of impact of online courses
- The role of cognitive and non-cognitive factors as predictors of academic performance: identifying the determinants of disengagement from higher education

➤ **Université des Mascareignes** ³⁰²

- Depts include Faculty of Engineering - ICT
- Research areas include: Climate Change & Environment, Secure Societies, ICT-enabled technologies, eHealth, Cryptography

Examples of research expertise and types of projects undertaken are provided below:

- Fast and Efficient Algorithms for Web Information Retrieval (completed 2014)
- Use of ICT/Distance learning in Education (2010 -) - creation of a platform for a virtual campus
- E-marketing/Social Media (2012 -) - analysis of use of social media as relationship marketing tool in the retail sector
- Impact of CRM in Higher Education based on case of Université des Mascareignes
- Strength development in soils of volcanic origin, stabilized with fly ash (completed)
- Web/mobile based traffic fluidity monitoring at Bel Air/ Rivière Sèche (completed 2014)
- Heuristic Search Procedures for Cryptanalysis (PhD research, 2014 - 2018)
- Just-in-time diabetes assistance using mobile and web technologies (completed 2014)

➤ **Middlesex University, Mauritius** ³⁰³

- Research areas include: User Interfaces, Big Data, Cloud Computing, Business Information Systems

³⁰² <http://www.udm.ac.mu/>

³⁰³ <http://www.mdx.ac.uk/facilities/location/mauritius/index.aspx>

Examples of types of research projects undertaken are provided below:

- Assessment of energy efficiency metrics - Evaluation of maturity of Green ICT practises at organisational level
- Study of the ubiquitous usage of mobile services and applications for successful m-Government deployment in the Mauritian ecosystem
- Data governance relative to the concept of Big Data
- Introduction of augmented reality as a pedagogical tool to enhance learning at tertiary level in Mauritius
- Personal Carbon Footprint Analysis - develop a carbon management framework to assess, reduce and sensitize employees within tertiary education institutions in Mauritius
- An environment for web-based visualization and collaboration
- User Centric Software Engineering for Intelligent Environments
- Using visualisation tool for teaching Java Programming to novices

➤ **Mauritius Institute of Health**

- Research areas include: Health systems Research, epidemiological studies and the evaluation of health programmes

Examples of research projects undertaken are provided below:

- Use of ICT tools in Healthcare and home follow-up of patients - monitoring and in-home follow-up of patients suffering from Type 2 Diabetes
- A study of ehealth prospects and challenges in Mauritius
- HIV Infection and risk behaviour among seamen in the Indian Ocean (completed 2009, funded by the Indian Ocean Commission (COI))
- Medicine price availability, affordability and price components in the Republic of Mauritius (completed 2009, funded by WHO)
- International tobacco control (ITC) policy evaluation project: ITC Mauritius survey (Cohort Study) (Completed in 2012, funded by the University of Waterloo)
- Mauritius birth defects registry (Commenced 2011, funded by the Ministry of Health and WHO)
- National Cancer Registry (Commenced 2005, funded by the Ministry of Health and WHO)
- Social and Economic Determinants of Health (Completed 2013, funded by the WHO)
- Contraceptive Prevalence Survey 2014 (Completed 2016, funded by the UNFPA)
- KABP of Breastfeeding in Mauritius (2013 - 2017, funded by Ministry of Health and Quality of Life)

- Health and Socio-economic impact of severe and fatal road traffic injuries in the island of Mauritius (due to be completed by Oct 2018)

➤ **Mauritius Sugarcane Industry Research Institute**

- Research areas include: Sugarcane agronomy, biopesticides, production of bioplastics, Molecular markers for earliness/disease resistance, Crop productivity using historical data and satellite imagery, Land use change detection, Sugarcane biomass evaluation, Bioinformatics for sugarcane genome studies, and pathogens characterisation

Examples of research projects undertaken are provided below:

- 2010 Land Use Map of Mauritius using satellite imagery (2008 - 2011)
- Production Environment of sugarcane crop for Miller/-Corporate planters (2000-2010). Project Crop improvement 4.7 (2009 - 2014)
- Efficient conjunctive use of water for sustainable sugar cane production (software development for real-time irrigation management) (2010 - 2015, funded by the EU Sugar Research Program)
- Weed Identification and Knowledge in the Western Indian Ocean (database and software development) (2013 - 2016, funded by the EU ACP-Sugar Research Program)
- Production Environment of sugarcane crop for Miller/-Corporate planters (2000-2010). Project Crop improvement 4.7 (2011 - 2016, funded by the EU ACP-Sugar Research Program)
- Evaluating the sugarcane yield potential of non-miller planters in the Eastern and Northern sectors using GIS mapping (2016-2020)
- Identifying abandoned lands, using GIS and satellite imagery, and evaluating the yield potential of cane lands among non-miller planters (2016-2020)
- Setting up of a Mauritius Barcode of life (MBOL): Application of DNA barcoding for agricultural insect pest management - The project aims at creating a comprehensive DNA barcode data for insect pests in Mauritius which will help to prompt identification of pest problems and to generate DNA Barcodes of parasitoids (beneficial insects) of local pests. The final objective is to develop the Mauritius Barcode of Life database (MBOL), which will be fully a searchable database for all barcodes generated in this study. (2017-2019, Funded by Mauritius Research Council)
- Leveraging cloud computing to build advanced data analytics platform for sugarcane research and crop monitoring - New sugarcane varieties are developed through a hybridization and selection programme. It relies heavily on IT operated systems for handling the voluminous data generated. Data stored goes back to 50 years. The data available also include climatic and crop data. The objective of the project is to take advantage of cloud computing to provide cost effective solutions to safeguard the information stored and provide

ubiquitous access, develop user-friendly data analytics and reporting tools. (2017-2019, Funded by Mauritius Research Council)

- Bioinformatics - With the advent of next generation sequencing, there has been an exponential growth in nucleic acids sequence data. Several projects at the MSIRI (RADseq for MAS, whole genome sequencing of pathogens, transcriptomics for differential gene expression) have generated a wealth of data that need to be stored and analysed. In addition, a wealth of sequence data is available from external databases for public use. To meet the needs for manipulating such large volumes of data, Bioinformatics tools with a local server are required. Several applications dealing with sequence data manipulation are installed and are currently being used for daily bioinformatics activities. It is also connected to a 30 mbps internet fibre in order to be able to access external servers remotely for big data transfer and manipulation.

Projects:

- Application of CRISPR, a new breeding technique, to sugarcane improvement
- QTL mapping and identification of molecular markers linked to early ripening, high sucrose and fibre content
- Application of genomic selection to the breeding programme of sugarcane
- Molecular diversity of new varieties introduced in germplasm collection for breeding purposes
- QTL mapping and identification of molecular markers for Sugarcane yellow leaf virus resistance
- Development of molecular diagnostic tools for major sugarcane diseases
- Sugarcane yellow leaf virus: genetic diversity studies of the virus.
- Developing applications with drone technology for monitoring and improving sugarcane production - The use of remote imagery captured by drones has tremendous potential to identify variations in the fields. Such images have high spatial and temporal resolutions and can be applied in zonal mapping, quantify biotic (pest, diseases, weeds) and abiotic (moisture stress, nutrient deficiencies) variables so that corrective measures can be taken. Drone system equipped with multi-spectral sensors together with associated software for image interpretation and analysis will be used. (2017-2020)

10.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners
Energy	Smart Environment/Grids; Low Carbon Electricity Supply; Energy Efficiency; Alternative Fuels	University of Mauritius, University of Technology, Mauritius Sugarcane Industry Research, Mauritius Research Council; Charles Telfair Institute
Climate Action	Climate monitoring, Sustainable Environment Management, Waste Management, Geospatial Analysis	University of Mauritius, University of Technology, Mauritius Sugarcane Industry Research, Mauritius Research Council, Middlesex University, Université des Mascareignes
Sustainable Agriculture & Maritime Research	Sustainable Agriculture; Land use change; Real time irrigation management using Met data; Bioeconomy; mAgriculture	University of Mauritius, University of Technology, Mauritius Sugarcane Industry Research Institute
Smart Green & Integrated Transport	Smart Mobility, Green Transport	University of Mauritius, University of Technology, Université des Mascareignes, Mauritius Research Council
eHealth	Integrated Healthcare, Health Monitoring for diabetes and other conditions	University of Mauritius, University of Technology, Open University of Mauritius, Université des Mascareignes; Mauritius Institute of Health; Mauritius Research Council

10.5.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	University of Mauritius (Mechanical and Production Engineering Dept): Adaptive Coding Techniques for Data Transmission, Growth of Nanostructured Materials
Advanced Computing	University of Mauritius (Computer Science and Engineering Department): Intelligent/Computational Intelligent Systems: Neural Networks; Fuzzy and Immune Systems, Quantum Computing University of Technology Mauritius (School of Innovative Technologies & Engineering): Scientific

	<p>Computing</p> <p>Mauritius Research Council: Simulation Software</p> <p>Open University of Mauritius: Simulation Software</p>
Future Internet	<p>University of Mauritius (Computer Science and Engineering Department): Software agents, Software oriented services</p> <p>University of Technology Mauritius (School of Innovative Technologies & Engineering): Mobile Computing, Future Internet</p> <p>Université des Mascareignes - Softwares and Services, Heuristic Search Procedures for Cryptanalysis, Mobile programming</p> <p>Middlesex University, Mauritius: Cloud Computing</p>
Content Technologies & Information Management	<p>University of Mauritius (Computer Science and Engineering Department): Metadata Development, Ontology Engineering</p> <p>Open University of Mauritius: Content Access and Analytics, Data Mining, Advanced Interfaces</p> <p>Middlesex University, Mauritius: User Interfaces, Big Data</p> <p>Université des Mascareignes - algorithms for web information retrieval, customer relationship management in higher education</p> <p>Mauritius Sugarcane Industry Research Institute - Statistical analysis and visual computing, big data technologies</p>
Robotics	<p>University of Mauritius (Mechanical and Production Engineering Dept): Computational Intelligence, Human-Computer Interaction</p> <p>Open University of Mauritius - Cognitive Systems, Advanced Interfaces</p>

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>University of Mauritius (Computer Science and Engineering Department): Health Patient Records, Healthcare Information Systems</p> <p>University of Technology Mauritius (School of Sustainable Development and Tourism): Occupational Safety and Health, Environmental Health</p> <p>Open University of Mauritius – eHealth, Integrated Care</p> <p>Université des Mascareignes - eHealth</p> <p>Mauritius Research Council & Mauritius Institute of</p>

	Health – Understanding Health, Wellbeing and Disease
Food Security, Sustainable Agriculture	<p>University of Mauritius (Dept of Chemical & Environmental Engineering): Sustainable Agriculture & Bio-Economy</p> <p>University of Technology Mauritius (School of Sustainable Development and Tourism): Supporting development of bio-economy</p> <p>Mauritius Research Council – Aquatic Living Resources</p> <p>Mauritius Sugarcane Industry Research Institute - Development of biopesticides, production of bioplastics, Sugarcane productivity in various agro-ecological zones</p>
Energy	<p>University of Mauritius (Dept of Chemical & Environmental Engineering and Mechanical and Production Engineering Dept): Energy engineering and management, Renewable energy technologies; Technology Transfer of Renewable Energy Technologies, Energy Security access and efficiency</p> <p>University of Technology Mauritius (School of Sustainable Development and Tourism): Energy Efficiency Management Programs</p> <p>Mauritius Research Council: Low-Carbon Electricity Supply; Alternative Fuels and Mobile Energy Sources; New Knowledge and Technologies</p> <p>Charles Telfair Institute: Green ICT</p> <p>Mauritius Sugarcane Industry Research Institute - Efficient use of energy resources in sugarcane processing</p>
Smart, Green and Integrated Transport	<p>University of Mauritius, Department of Chemical & Environmental Engineering: Green Transport</p> <p>University of Technology, School of Sustainable Development and Tourism: Socio-Economic Research Transport Management Systems</p> <p>Mauritius Research Council: Socio-Economic Research and Forward Looking Activities for Policy Making</p> <p>Université des Mascareignes: Web/mobile based traffic fluidity monitoring</p>
Climate Action, Environment, Environment, Resource Efficiency and Raw Materials	<p>University of Mauritius (Dept of Chemical & Environmental Engineering): Waste management; Waste-to-Energy; Climate change, Environmental impact assessment, Degradability/biodegradability of solid wastes, Solid Waste Management</p> <p>University of Technology Mauritius (School of Sustainable Development and Tourism): Sustainable Environment Management, Tourism, Leisure, Society and Education, Green IT, Sustainability Assessment,</p>

	<p>Tourism development and assessment, Transition Towards a Green Economy and Society, Service Experience and Economy</p> <p>Université des Mascareignes: Climate Change & Environment</p> <p>Mauritius Sugarcane Industry Research Institute: Identification of agro-ecological zones' boundary with climate change for adapted sugarcane production and management</p> <p>Middlesex University: Geospatial Analysis</p>
Inclusive, Innovative and Reflective Societies	<p>University of Technology Mauritius (School of Sustainable Development and Tourism): eServices</p> <p>Mauritius Research Council: Inclusive Societies</p> <p>University of Technology Mauritius (School of Innovative Technologies & Engineering): Technology-enhanced Learning</p> <p>University of Mauritius, Virtual Centre for Innovative Learning Technologies: Technology enhanced learning</p> <p>Charles Telfair Institute: Technology-enhanced Learning</p> <p>Open University of Mauritius: Technology-enhanced Learning; eGovernment Services</p> <p>Université des Mascareignes: Technology-enhanced Learning; social media and e-marketing</p>
Secure Societies	<p>University of Technology Mauritius (School of Sustainable Development and Tourism): Resilience to Crises and Disasters</p> <p>Université des Mascareignes: Secure Societies</p> <p>Open University of Mauritius: Cybersecurity</p>

Level of Research Maturity

Mauritius has a good research base. Institutions have good experience undertaking research at national level and are building a track record of collaborative research both through FP7 and ACP programmes. Research capacity has been validated by NCB in cooperation with the institutions listed. There has been an increase in the number of PhD students graduating and number of peer reviewed scientific publications over the past 15 years.

Now that ICT has become the third most important economic pillar, there is a sense of urgency in the Government and in the research community to leverage the opportunity that the IST-Africa Strategic Partnership presents. This is reflected by the enthusiasm to get involved in the development of Living Labs in Mauritius, to reinforce the impact of other government activities.

While there is clearly a strong – and successful focus on technology adoption and developing applications, strengthening research capacity within the country is on the Government's agenda. There is now a much higher level of awareness of pan-African and international ideas of what level of research maturity is required and a greater focus on the development of research results with the potential to achieve sustainable socio-economic impact.

Joining the IST-Africa Consortium has enabled the National Computer Board to raise awareness at the highest level of the Mauritian research community about the Framework Programme, the types of ICT related research being undertaken internationally and the opportunities available to partner with other countries in research proposals which may benefit Mauritius and the region. Participation in IST-Africa also provides the opportunity to learn about projects and good practices from other countries that can be adapted and replicated locally. Research institutions in Mauritius have become much more aware of the Framework Programme and specific calls and more pro-active about research.

Up to September 2018 Mauritius organisations have been successful in 2 Horizon 2020 projects

- H2020-ICT-2016-INT- IST-Africa 2016-2018 (CSA) - National Computer Board
- H2020-MSCA-RISE-2016 - SLAFNET (MSCA-RISE) - University of Mauritius

10.5 Innovation Spaces

Innovation Spaces currently supported by the Government of Mauritius include: StartMe Up; *NCB Technopreneurship Unit*³⁰⁴ (2011, rebranded 2017) and La Plage (initiated in 2016). These Innovation spaces offer a mix of Pre-Incubation, Incubation (physical and virtual) and Accelerator services.

StartMe Up³⁰⁵ is a public private partnership initiative launched by the Mauritius Research Council (MRC) in September 2017, in collaboration with the Ministry of Finance and Economic Development (MoFED), and six Accredited Private Sector Business Incubators (Ceridian App Factory, La Plage Factory, Mauritius Startup Incubator, Turbine, Ventures AA and Verde Ventures) to create a sustainable entrepreneurial ecosystem in Mauritius.

The scheme is funded by the National SME Incubator Scheme (NSIS). It provides pre-incubation, incubation and acceleration, support, co-financing, business advice and training for: individuals with innovative business ideas; pre-startups/early start ups willing to establish themselves and well established start-ups and or SMEs willing to exploit new markets and accelerate their business activities. Previously MRC had an Incubator.

Ceridian Learning Centre³⁰⁶ provides ICT training courses. La Plage Factory³⁰⁷ provides incubation services and co-working space. Mauritius Startup Incubator³⁰⁸ provides mentoring services and

³⁰⁴ <http://technopreneur.ncb.mu>

³⁰⁵ <http://www.mrc.org.mu/English/News/Pages/startmeup.aspx>

³⁰⁶ <http://ceridianlearningcentre.com>

office space. Turbine³⁰⁹ provides incubation and acceleration services and co-working space. Ventures AA³¹⁰ provides office space, mentoring and financial support. Verde Ventures³¹¹ provides a mix of pre-incubation, incubation and acceleration services, including sourcing financing.

The National Computer Board (NCB) is supporting entrepreneurship through the **Technopreneurship Programme**, Microsoft BizSpark Program and NCB/MICT **TechIdeaSpace Programme** launched in November 2014. In 2017 the ICT Incubator Centre was rebranded as the Technopreneurship Unit to promote and inspire start-ups with Innovation ICT solutions and services, develop a community of ICT Entrepreneurs and encourage Ideation, Innovation and Creativity among ICT start ups and Technopreneurs. It provides business planning support, mentoring and guidance in relation to different financing schemes available to fund ICT projects in Mauritius.

In 2016 the Government initiated "La Plage"³¹² as an Incubator/Accelerator project under a Public-Private Partnership. It aims to create a conducive 'ecosystem' for high-tech entrepreneurship; boost the quality of competencies available; promote Mauritius as an international ICT destination and attract more investment and obtain the suitable visibility and accountability by demonstrating the ability of the Mauritian ICT sector to deploy technologies able to challenge international contracts. It provides incubation services and co-working space.

The Ebene Cybercity near Port Louis is home to the Ebene Accelerator, which was established by the Ministry of Finance and the Orange Mauritius Group in 2013. Located in Orange Tower, the accelerator provides free hosted space for four months with the next four months at a 50% discount.

Launched by ENL Group in 2015, Turbine³¹³ is a not-for-profit co-working space and start-up incubator in Mauritius. Turbine is a national incubator accredited by the Mauritius Research Council (MRC) and takes a 10% equity stake in supported enterprises for incubation services.. Turbine works closely with Sting, the leading Accelerator in the Nordics, and seed funding of up to Rs 1 million is available on a competitive basis from Compass Venture Capital, and associated company.

³⁰⁷ <http://www.coworking.mu/incubator>

³⁰⁸ <http://www.mauritius-startup-incubator.com/en/mauritius-startup-incubator-home/>

³⁰⁹ <https://www.turbine.mu/incubation/>

³¹⁰ <http://ventures.angloafrican.com/>

³¹¹ <http://www.verdefrontier.mu/ventures/>

³¹² <http://www.coworking.mu/incubator/>

³¹³ <https://turbine.mu>

11. REPUBLIC OF MOZAMBIQUE

11.1 Introduction

The Republic of Mozambique is located in Southern Africa, bordered by Malawi, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. The Mozambique Channel is to the east. Mozambique has an area of 799,380 km² and eleven provinces: Cabo Delgado, Niassa, Nampula, Tete, Zambézia, Manica, Sofala, Inhambane, Gaza, Maputo Province and Maputo-Cidade. The population is estimated at 28.9 million inhabitants (August 2017 National Population Census³¹⁴) with a literacy rate of 58.8%. Fifty-two percent of the population is aged between 15 and 64 (median 17 years)³¹⁵. The capital city is Maputo with a population of 1.102 million (2018 CIA World Factbook). Portuguese is the official language and there are several indigenous languages as national languages. English is widely used in business and government.



Despite fiscal reforms (including the introduction of a value-added tax and reform of the customs service), Mozambique remains dependent upon foreign assistance for more than half of its annual budget, and the majority of the population remains below the poverty line.

Subsistence agriculture continues to employ the vast majority of the country's work force and smallholder agricultural productivity and productivity growth is weak. Heavy reliance on aluminium, which accounts for about one-third of exports, subjects the economy to volatile international prices. Estimated GDP growth in 2014 was 7%, with agriculture representing 29%, industry 21% and services 50% (CIA World Factbook).

Mozambique reformed its telecommunications landscape in 1992. There is one fixed line operator - Telecomunicações de Moçambique (TDM) and three mobile operators providing services - mCel, the incumbent mobile subsidiary of TDM, Vodacom Mozambique (2003) and Movitel (2012). The merger between TDM and mCel will be completed during December 2018. This consolidation has been planned since 2016 as part of the restructuring of public sector business ongoing by the Government.

While the mobile sub-sector experienced growth rates with the introduction of competition, growth has slowed due to ineffective cost structures and insufficient infrastructure. In terms of Communications there were 83,708 fixed phone lines in use; 13.58 million mobile phone subscribers and Internet penetration is 5,39 million users in October 2017 (INCM, Mozambique).

³¹⁴ www.ine.gov.mz

³¹⁵ CIA Factbook

During 2013 the Government initiated a revision of the 2004 Telecommunications Act to support the development of infrastructure and greater competition.

There are 4 public universities, 14 public Higher Education Institutions, 11 private Universities and 20 private Higher Education Institutions. Twenty-two institutions are dedicated to research activities, 15 of which are government institutions and 7 private.

In terms of ICT infrastructure, there are two submarine fibre optic cables - Seacom (2009) and EASSY (2010). The national broadband backbone provides an optical fibre connection to all 11 provincial capitals. There is an Internet Exchange Point in Maputo. Purchase of international capacity is facilitated for eGovernment users through the GovNet projects and for Universities through MoRENet.

The Mozambique Research and Education Network (MoRENet) was set up in 2005 by the Ministry of Science and Technology as part of the ICT Policy Implementation Strategy as a national data network to interconnect academic and research institutions. MoRENet is a member of the Ubuntunet Alliance and a partner in the Africa Connect project³¹⁶ which is supporting improved connectivity for research and education within Sub-Saharan Africa by the provision of research networking infrastructure within the region and organising a direct interconnection to GÉANT.



11.2 ICT Background

In 1998, the Government of Mozambique established an Information and Communication Technology (ICT) Policy Commission, chaired by the Prime Minister, whose primary mandate was to draw up a national ICT Policy. Following a two-year nationwide debate involving all stakeholders (public and private sectors, civil society, academic and research institutions, donor agencies, etc), the national ICT Policy was approved by the Council of Ministers in December 2000. In June 2002, an ICT Policy Implementation Strategy was adopted, which provided concrete benchmarks and targets to be achieved and indicators to assess progress. Human capacity, infrastructure, legal and regulatory framework, e-Government, content, applications and business development were selected as key areas of intervention to ensure that ICT was an enabler and cross cutting issue in all sectors and development programmes.

e-Government is a key element in the ICT Policy Implementation Strategy to support the Public Sector Reform Strategy of improving public sector performance, efficiency and cost-effectiveness through the use of ICTs.

As part of the implementation of the ICT Policy Implementation Strategy and mobilization of resources, many ICT projects were launched in the public sector including the Electronic

³¹⁶ <http://www.africaconnect.eu>

Government Network Project, SchoolNet Project, eSISTAFE (State Financial Administration System), the Land Information Management System, SISCAL (System for Licensing and Registration of Enterprises), Criminal Registry System, Civil Registration System, Civil Identification Registry System, Emigration Registry System, Driving License Registry System. The private sector has also been very innovative in providing many eCommerce and eBusiness applications to citizens and the public sector.

The Electronic Government Network Project (GovNet) was launched to provide the Government with a high-capacity electronic communication infrastructure that is reliable and safe for 'rapid, efficient and effective transportation of information'. This infrastructure is designed to support the implementation of information systems and the installation of all applications that will enable Government-to-Government (G2G), Government-to-Business (G2B), and Government-to-Citizens (G2C) operations. The Electronic Transaction Law was approved in 2017.

From 2015 the ICT Policy, ICT Policy Implementation and the eGovernment Strategy documents were revised, resulting in new three documents, namely Information Society Policy, Information Society Strategic Plan and Information Society Operational Plan, which were submitted for approval by the Government.

In 2017, following the approval of the Electronic Transactions Law (Law No. 3/2017), which establishes the principles, general rules and legal regime for electronic transactions, electronic commerce and electronic government, the Information and Communication Technology National Institute (INTIC) became the regulator of ICTs in Mozambique. The National Institute for Electronic Government (INAGE) was established as a new entity to implement Electronic Government Services in Mozambique.

11.3 Current ICT Initiatives and projects

Mozambique is currently investing in several ICT projects as a consequence of the gradual realisation of the ICT Policy, its implementing strategy and the Mozambican eGovernment Strategy. ICT Initiatives are currently ongoing at national level in the areas of eGovernment (Electronic Government Network, Government Portal, Capacity Building, State Financial Administration System, Mozambique eGovernment Communication Infrastructure project, National System of Civil Registration, Biometric Driving Licence and Motor Registration Systems, Biometric ID Card and Passport, Criminal Registration System), Digital Divide (Provincial Digital Resource Centres, Multimedia Community Centres Programme) and CyberSecurity.

11.3.1 Electronic Government Network (GovNET)

GovNet project commenced in 2004 initially as a Pilot Phase aimed at providing the necessary support in the definition of the technical (hardware, software, networking) requirements, communication protocols to be put in place, naming conventions to be established, definition of security rules. During the Pilot phase central level of the government located in Maputo was

connected. Due to the successful implementation of the pilot phase, the Italian Government extended its funding and the Extension Phase took place benefiting 4 to 5 institutions at provincial level. From 2010 a third phase expanded connectivity to the districts to cover all of the 128 existing districts in Mozambique. The last phase of the project, focused in the extension of the Network to the Districts, in the period from 2010 to 2015, ending with 63% districts covered. The remaining districts will be covered by 2019.

The next phase of the GovNET project will begin in 2019, with the aim of training local technicians from all Districts linked to GovNet in ICT technical matters so that urgent, "simple and small" problems can be solved without intervention of the Provincial Digital Resource Centers (CPRDs). It aims to introduce district officials to using computers and basic concepts of information and communication technologies.

Funding: Italian Government, World Bank and Government of Mozambique, and implemented by the ICT National Institute (INTIC), which was established in May 2011 according to Law No 9/2011 (formally the ICT Policy Implementation Unit- UTICT).

Geographic scope: Government agencies at national level

11.3.2 Government Portal

The Government Portal initiative is aimed at providing a single-entry point to Government information and services which are organised according to the interests and needs of citizens, allowing access anytime, anyplace and anywhere. The Government Portal was launched in 2006 by the former Prime Minister Luisa Dias Diogo. Following that several Provincial Government Portals have been developed as district portals.

Funding: Italian Government through the GovNET Project described above

Geographic scope: Government agencies at national level

11.3.3 State Financial Administration System eSISTAFE

The State Financial Administration System (e-SISTAFE) was implemented to provide financial administration services through the Internet using a single Bank account for all government institutions expenditures. Through this system the institutional budgets are assigned, and monthly reports are also presented allowing the Ministry of Finance to present the annual State Financial Report in a timely fashion, present quarterly reports about the execution of the budget and submit the proposed State Budget to the Parliament before 30th September each year.

The project also demonstrated that government transactions such as G2G (government-to-government), G2B (government-to-business) and G2C (government-to-citizen) could be done more effectively and efficiently when handled electronically so long as all the security mechanisms are taken.



The Ministry of Finance, through the Development Centre of Financial Information Systems (CEDSIF), is implementing this project.

Funding: World Bank

Geographic scope: Government agencies at national level

11.3.4 Harmonization of the GovNET and eSISTAFE Infrastructure

In order to optimize Government resources, by minimizing the expenditure in GovNET and eSISTAFE infrastructures, in 2015 the Government started the harmonization of these two infrastructures. It is expected that by 2019, that both Government institutions will be using a unique common communication platform for Internet, Email and financial transaction, improving the savings in Government electronic communication issues.

11.3.5 Mobile ICT Unit

The Mobile Information and Communication Technologies (ICTs) Unit, which was allocated to the Inhambane Provincial Digital Resource Center (CPRD) in 2006, is a multi-purpose mobile room, equipped with computers and communication facilities. It is used as a point of access for citizens and public officials in the districts, computer and communication facilities, as well as access to training and awareness, and other events being used for education campaigns in health, agriculture, etc.

The Mozambican Mobile Unit provides training courses in districts isolated from ICT facilities to address the problem of ICT skilled human resources across the country. The training is provided in a mobile unit set up as a classroom, equipped with 10 computers. This mobile ICT technology provides relevant programs for public servants and other community members. Within the Mobile Unit, these groups can also access a variety of information via the Internet and email.

Funding: Initially funded by UNDP and Italian Government, now funded by Government of Mozambique

Geographic scope: Districts

11.3.6 Provincial Digital Resource Centres (CPRDs)

Provincial Digital Resource Centres (CPRDs) concentrate ICT infrastructure, skills and investment by providing a single-entry point for ICT deployment and activity in the provinces, stimulate local demand and use of ICT by all sectors of development and support capacity building and development of local content. ICT Policy Implementation Unit (UTICT) established the first CPRDs in 2004 in the Provinces of Inhambane and Tete with funds provided by UNDP.

Based on demonstrating an impact in these provinces through the provision of ICT training courses, computer maintenance, network administration, data base designs and many other ICT services

that were not offered at a provincial level further funding was provided by UNDP, Microsoft, Government funds through the Public Sector Reform Program and Italian Government, to facilitate the extension of these facilities in 6 more provinces (Nampula, Gaza, Sofala, Zambezia, Cabo Delgado and Niassa) from 2005 to 2009.

Funds were secured through the STIFIMO project funded by the Finnish Government to establish three additional centres in the remaining 3 provinces (Maputo, Maputo City and Manica). The CPRD in Manica Province was established in 2017. The CPRDs have been working as local hubs with a multi-sectoral and multi-functional approach, fostering linkages with local media to multiply the benefits of Internet connectivity and rural access to information, reducing internal digital divide.

Funding: UNDP, Italian Government, Microsoft Corporation, Mozambican Government and Finnish Government

Geographic scope: National

11.3.7 National System of Civil Registration (SINAREC)

This project aims to efficiently and effectively plan for and implement social services for citizens, promote democracy through the availability of efficient and correct registers for voting, promote an efficient, effective and fair government, etc. The project will run in phases, with a Pilot Phase which will apply a birth registration system with a unique ID number to a chosen set of 1000 peoples and pilot the registered population as the core of the eGovernment initiative including investigating and testing integrations and interoperability to the rest of the eGovernment projects.

Partners: Ministry of Science and Technology, Ministry of Justice, the Mozambican International Bank and the Swedish Tax Agency

11.3.8 Biometric Driving Licence and Motor Vehicle Registration Systems

This system is used to produce new driving licence cards without the use of special equipment, which has visible security features to facilitate a quick visual check, and it contains invisible and/or confidential security features for a second-level check.

The Motor Vehicle Registration System is used to register motor vehicles, issue registration plates and motor vehicle permits, deregistration of motor vehicles, change of vehicle particulars, change of ownership of a motor vehicle, financial information and accountability, transaction auditing and management information reports. The two systems developed to provide driving licences and vehicle number plates will match the standard and format used in the SADC region.

Funding: World Bank

Geographic scope: National

11.3.9 Biometric ID Card and Passport

The new ID card is a huge step forward in solving problems of citizens who previously had to wait for months or even years for their ID cards. It incorporates biometrical features, which are used to establish a person's identity which can later be compared with stored reference data. The biometric identifiers used in this card are the fingerprint and the facial image, making it a secure identification document that is difficult to forge. The system was developed by Semlex, a Belgian company that invested 50 million dollars in setting up the new ID system and passport.

11.3.10 Criminal Registration System

This application aims to facilitate the exchange of records between the provincial delegations and central institutions about the criminal status of the citizens, which is then used to issue criminal certifications in a more timely fashion. This certification is often required for new employments, bank loans etc.

Geographic scope: National

11.3.11 Multimedia Community Centres (MCC) Programme

This program aims at providing a means by which the community has access to information using a wide range of information and communication technologies through a single point. This is also serving to reduce the digital divide, reduce poverty by enabling people to solve development problems that the community faces and strengthen the community capacity.

It is mainly implemented by the Ministry of Science and Technology, Higher, Technical and Professional Education, with a contribution of different institutions including the Centre of Informatics of the Eduardo Mondlane University (CIUEM), the National ICT Institute (INTIC) and UNESCO.

Funding: World Bank, UNESCO, UNDP

Geographic coverage: National

11.3.12 National Cybersecurity Strategy

Mozambique's National Cyber Security Strategy (2017-2021) describes the approach to ensure that the country guarantees a secure and resilient cyberspace that is used safely by the Government, private sector, civil society and other institutions. This strategy establishes the commitment of the Government of Mozambique to ensure safe cyberspace and contributes to socio-economic development.

11.4 National ICT Research Capacity and Priorities for Cooperation

11.4.1 National Priorities

National ICT Research Priorities include:

- eHealth - Self-management of health; Improved diagnostics; Data collection; Health care provision and Integrated Care; Research on HIV AIDS, Malaria, Tuberculosis, Meningitis, Cholera; Parasitological research, Virology and molecular biology research. Institutions involved include: UEM-Faculty of Medicine, Ministry of Health - National Institute for Health, Higher Institute for Health Science, Pedagogical University (UP) and some NGOs
- Food Security and Sustainable Agriculture - Sustainable agriculture and forestry; Sustainable and competitive Agri-food sector for safe and healthy diet; Research on type of hydraulic solutions that need to be put in place to overcome problems related to drought; Research on agricultural logistics, market access, value chains and on services required by the technology start-ups (finance, consultation, etc.). Institutions involved include: Ministry of Agriculture, Agrarian Research Institute of Mozambique (IIAM), Ethnobotanical Research and Development Center (CIDE), Pedagogical University (UP), FAO and other NGOs
- Energy - Alternative Energy Sources. Institutions involved include: Ministry for Energy
- Future Internet - Networks, Software Services and Wireless Communications. Institutions involved include: INTIC, INCM, CIUEM
- Technology-enhanced Learning: Platforms and pedagogies; Capacity building programs
- eGovernment - Research on service delivery transformation and use of ICTs and eGovernment architectures as a catalytic force for public sector reform, Research on innovative services on health and education, including science laboratories, and government information and content.
- ICT for Rural Development - Research on robust and well standardized, easy maintenance access terminals for rural areas; Research on low cost wireless solutions to address digital divide; Research on low cost public terminals, business models, universal access, shared network infrastructures, security architectures; Research on community based content and service needs, tailored to cultural and linguistic context of rural areas
- Entrepreneurship & Socio-economic development - Promoting entrepreneurship using ICT; Entrepreneurship for poverty alleviation

11.4.2 National Research Capacity

The following universities and research centres in Mozambique are undertaking ICT-related initiatives:

- **Eduardo Mondlane University (UEM)**³¹⁷
 - Depts include: Electronic Engineering and Informatics Departments and CIUEM
 - Research areas include: Agriculture, Marine Science, Fishery, Building, Ecotourism, Health, Social Sciences, Environmental Sustainability, Economic Development, Networks, Software Services, Privacy and Trust and Wireless Communications
- **Mozambican ICT Institute (MICTI)**
 - Research areas include: ICT, Environment, Science & Engineering Education / Training, Manufacturing, Energy
- **Mozambican Catholic University (UCM)**³¹⁸
 - Depts include: Faculty of Engineering: Department of Information Technology and Faculty of Management of Tourism and Informatics: Center for Research in Sustainable and Technological Development (CIDST).
 - Research areas include: Sustainable and Technological Development, Environment, Tourism, Social Education, eCommerce and Electronic Entrepreneurship
- **Higher Polytechnic and University Institute (ISPU)**
 - Depts include: IT and Scientific Investigation
 - Research areas include: Social and Political Sciences, Rural and Economic Development
- **Pedagogical University (UP)**³¹⁹
 - Depts include: Social Science and Health
 - Research areas include: Social Sciences, Health, Technology-enhanced Learning
- **Higher Institute for Health Sciences**
 - Research areas include: Public Health, Child and adolescent health/nutrition, Health systems, parasitology, virology and molecular biology, evaluation and analysis of health status, policy analyse and formulation, training and Post-graduate in health sciences
- **São Tomás University (USTM)**³²⁰
 - Research activities related to the use of ICT and Entrepreneurship for poverty alleviation
- **Mozambican Higher Institute of Science and Technology (ISCTEM)**³²¹

³¹⁷ <http://www.uem.mz/>

³¹⁸ <http://www.ucm.ac.mz/>

³¹⁹ <http://www.up.ac.mz/>

³²⁰ <http://www.ustm.ac.mz/>

³²¹ <http://www.isctem.ac.mz/>

11.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and discussion during the IST-Africa H2020 Workshop on 19 November 2014 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners include
eHealth / mHealth	Health Information Systems/Electronic Health Records; Maternal, Newborn and Child Health (MNCH); Health diagnosis and Surveillance - Malaria, hypertension, diabetes, cancer, cholera (during rainy seasons); Mechanisms and alarms to deal with compliance issues (remembering to take medication, attend clinic etc); Telemedicine and remote diagnosis	National Institute for Health; Ministry of Health; Eduardo Mondlane University (Faculty of Medicine); Higher Institute for Health Sciences; Pedagogical University
eAgriculture	Crop Management; Agri-food based applications	IIAM (Agricultural Research Institute); Eduardo Mondlane University; Pedagogical University; CIDE (Centre for Research and Development of plants):
Technology-enhanced Learning	Distance Learning; mLearning	National Institute of Distance Learning; Pedagogical University
Environment	Water Management; Agro Climatic Information for farmers	National Institute of Meteorology; Eduardo Mondlane University; IIA (Water Research Institute); University of Zambeze
eGovernment	Public Service Delivery, mGovernment services	INTIC

11.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Future Internet	INTIC: Networks, Wireless Communication Eduardo Mondlane University (CIUEM): Networks, Software and Services, Wireless Communication
Content Technologies & Information Management	National Institute for Education Development (INDE): Technologies for Language, Learning, Digital Preservation Pedagogical University: Technology-enhanced Learning

	INTIC: Content & Information Management Instituto Nacional das Comunicações de Moçambique (INCM) Mozambique Catholic University (Dept of Information Technology)
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Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	Eduardo Mondlane University (Medicine) Higher Institute for Health Sciences: Public Health, child and adolescent health/nutrition; Health systems, parasitology, virology and molecular biology, evaluation and analysis of health status, policy analyse and formulation, training and Post-graduate in health sciences Pedagogical University
Food Security, Sustainable Agriculture	Agrarian Research Institute (IIAM): Sustainable agriculture - Cereals; Roots and tubers Grain legumes; Cashew nuts; cotton; Big and small ruminants; poultry and pigs; Animal husbandry; Natural resource management including soils; and Forest Technology transfer and training CIDE (Centre for Research and Development of plants): Research on native plants, photochemistry Pedagogical University: Study of medical plants
Climate Action, Environment, Resource Efficiency and Raw Materials	IIA (Water Research Institute): Water Research (Disaster Management, Water & Sanitation, Ground water) University of Zambeze: Water Quality, Environmental Quality, Socio-economic impact of gold mining (Environmental risks) National Institute of Meteorology Eduardo Mondlane University UEM
Secure, Clean and Efficient Energy	Ministry of Energy: Alternative sources of fuel; Wireless energy sources

Level of Research Maturity

Mozambique has research capacity and a track record in collaborative research through participation in more than 20 FP7 projects, securing research funding of over **€3.36 million**.

Up to September 2018 Mozambique organisations have been successful in 8 Horizon 2020 projects with research funding of over €1 million across a range of thematic areas:

- HEALTH, H2020-PHC-2014-single-stage - **EMI-TB** (Instituto Nacional de Saúde)

- H2020-PHC-2015-single-stage_RTD - **EHVA** (Instituto Nacional de Saúde)
- H2020-WATER-2015-two-stage: **DAFNE** (Universidade Eduardo Mondlane); **SafeWaterAfrica** (Salomon Lda)
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** Instituto Nacional de Tecnologias de Informacao E Comunicacao
- H2020-SC5-2016-OneStageB - **FORAM** - Gondwana Empreendimentos E Consultorias Limitada
- H2020-SFS-2017-1 - **AfriCultuReS** (RIA) - Universidade Eduardo Mondlane
- H2020-MSCA-ITN-2017 - **ANTHUSIA** (MSCA-ITN-EJD) - Universidade Eduardo Mondlane

The level of research maturity is steadily strengthening, supported by the experience of being involved in internationally funded research and the impact of bi-lateral projects funded by a number of EU Member States. This is despite the difficulty created by the linguistic challenges for a Lusophone country trying to participate in international research projects. IST-Africa has made a significant contribution in this regard by facilitating relationship building with key stakeholders, exchange of experiences in Europe and Africa, focusing international attention on Information Society and ICT related challenges and opportunities in IST-Africa Partner Countries and providing opportunities to engage with international research stakeholders both in Europe and in Africa.

There is now a considerable sense of urgency in the Government and in the research community to build on recent successes and momentum achieved to date. While the primary focus is still on technology adoption and developing applications, there is an increasing focus on strengthening research capacity within the country, and facilitating the continued development of post-graduate programmes. Mozambique is one of a number of IST-Africa Partner Countries (including Uganda, Namibia and South Africa) that is investing in funding national research programmes.

11.5 Innovation Spaces

Even though a Business Incubator Strategy was developed through IPEME, traditionally there has been limited tech entrepreneurship support in Mozambique.

On 10 May 2012, by Decree No. 6/2012 of 10 May, the Council of Ministers created the Science and Technology Park located at Maluana to manage the flow of knowledge and act as a bridge between research and the market that enhances and increment, development, transfer and commercialization of technology and innovation. It is the duty of the Park to boost development in the areas of Innovation, Science and Technology and the communities in which it is deployed.

Mozambique Information and Communication Technology Institute (MICTI) was initially established within the University of Eduardo Mondlane to provide an Institute for Research and Learning and a Business and Technology Incubator.

Mozambique was a beneficiary through the Finnish government funding of the Southern African Innovation Support (SAIS)³²² Programme and STIFIMO Programme, both of which aimed to strengthen the national Innovation ecosystem in participating countries. The Maputo Living Lab³²³ was established in 2011 as part of a three-year project funded the Province of Trentino Italy to build capacity through Summer Schools for students and pre-Incubation through the Informatics Laboratory. RLabs Mozambique followed in later 2013 with funding support from SAIS 1.

Ideialab³²⁴ was established in 2010 and provides business development services as well as local content development. It organises a number of initiatives focused on supporting entrepreneurship, including regular 3 day ideate bootcamps organised with Standard Bank. IdeiaLab is the implementing partners in the Orange Corners Maputo co-working space supported by the Dutch Embassy, BancABC, Heineken and Shell. OCM provides access to the #BIZ incubation program, which organises workshops and events, mentoring, master classes, as well as business coaching. The Google for Entrepreneurs Startup WeekenD in Mozambique is promoted by IdeiaLab and UX. IdeiaLab is responsible for the business and entrepreneurship track of the Young African Leaders Initiative (YALI) in Mozambique. Maputo Campus is the Lusophone hub for this initiative.

Recent players include: MozDevz³²⁵ (2013) as a community of Application Developers; IPEME Incubator – which is operated by the Instituto Para Promocao Das Pequenas E Medias Empresas (IPEME³²⁶); and IDEARIO³²⁷, which was launched in Summer 2014 as a tech hub and co-working space offering Pre-Incubation and a 30 day Acceleration Programme. IdeiaLab³²⁸ was cooperating with the FemTech SAIS Programme in Mozambique.

MozDevz is a platform that connects students, professionals and enthusiasts in the Information and Communication Technologies (ICT) sector to the private sector and civil society organizations. MozDevz builds capacity of its constituents through development programs and skill tests, Hackathons, meetings and short training programs, with the ultimate goal of preparing and integrating them into the labor market through our network of partners

³²² <http://www.saisprogramme.com/overview/>

³²³ Ciaghi A, Villafiorita A, Chemane L, Macueve G, *Stimulating Development through Transnational Living Labs: the Italo-Mozambican Vision*, In IST-Africa 2011 Conference Proceedings, Paul Cunningham and Miriam Cunningham (Eds), IIMC International Information Management Corporation, 2011, ISBN: 978-1-905824-24-3

³²⁴ <http://www.ideialab.biz/en>

³²⁵ <http://mozdevz.idear.io/sobre-nos/>

³²⁶ www.ipeme.gov.mz

³²⁷ <http://idear.io/>

³²⁸ <http://www.ideialab.biz/>

12. REPUBLIC OF NAMIBIA

12.1 Introduction

Namibia is situated in South Western Africa, bordered by the Atlantic Ocean in the west, Angola and Zambia in the north, Botswana and Zimbabwe in the east and South Africa in the South. The country has a surface area of 824,292 km² with 14 administrative divisions. The population as at July 2018 was estimated at 2.533 million inhabitants with a literacy rate of 81.9%³²⁹. Fifty-nine percent of the total population is between the ages of 15 - 64, with a median age of 22 years. Windhoek, the capital city, has a population of 404,000 (2018, CIA World FactBook). Namibia is multi-cultural with 11 tribes. English is the official language, with 16 other languages spoken.



Namibia is one of the first countries to incorporate protection of the environment into its constitution with approx 14% of its land being protected including the Namib Desert coastal strip.

Namibia is an arid country with generally low and highly variable rainfall. Agriculture, largely subsistence, is the main economic activity for the rural population, contributing about 6.3% of GDP. Other activities include Industry (29.9%) and Services (63.8%) based on 2014 estimates. Diamonds, Minerals, Fish, Livestock and Livestock by-products are the country's principal exports.

In relation to Communications, according to figures provided by the Communication Regulatory Authority of Namibia (CRAN)³³⁰ there were 187,853 fixed phone subscribers, 2.66 million mobile phone subscribers and 1.58 million mobile Internet users in December 2016. The number of high-speed ADSL subscriptions (10 Mbps or above) significantly increased during the second half of 2016. Fibre to the home (FTTh) is gaining popularity in Namibia, with 158 subscriptions. However, fast residential wired broadband market has only 574 subscriptions (ADSL 10Mbps and above plus FTTh).

In terms of ICT infrastructure, the telecommunications backbone switching and transmission network was 100 percent digitalised in 1999 with state-of-the-art underground fibre-optic cabling. Direct communication satellite links exist with neighbouring countries as well as with the UK, USA and Germany. The West African Cable System (WACS) was launched in April 2012, providing Namibia's first link to global submarine cable network. The optic fibre cables have interconnected all major towns with a fibre point of presence. Fibre cables have also been extended to the borders of Angola, Zambia, Botswana and South Africa. The country has also deployed an IP/MPLS network

³²⁹ CIA World FactBook

³³⁰ CRAN Stats Newsletter December 2016

country wide with points of presence in all towns. Telecom is further investing in a nationwide terrestrial fibre backbone infrastructure with the aim to increase capacity on existing fibre infrastructure to fully utilise the WASC capacity. Modern infrastructure includes the rolling out of the Government's Regional ICT Hubs, the High-speed (3G/4G LTE) network. Namibia is also connected to the South African Far East (SAFE) submarine cable through South Africa.

Namibia has three cellular operators MTC, Paratus Telecom and TN mobile. MTC launched 4G during 2012. MTCs 3G network is deployed in over 95 percent of the country making access to the Internet available through their 3G devices and internet enabled phones, in partnership with Nokia Siemens and Motorola. This has been an enhancement of the existing GSM/GPRS/EDGE broadband technologies with increasing international capacity through VSAT Internet gateways.

In March 2014, Namibia established its own Internet exchange point (IXP) in collaboration with the African Union Commission through the African Internet Exchange System (AXIS) Initiative.

Namibia has two main public institutions: University of Namibia and Namibia University of Science and Technology, 36 vocational training centres and 9 skills development centres, one private University (International University of Management) and 1,450 schools. There are also several private colleges and open colleges operating in Namibia.

12.2 ICT Background

The Namibian Government recognises the value of Information and Communications Technology (ICT) as an industry to support socio-economic growth. The Namibian Government's *Vision 2030* aims at transforming Namibia into a knowledge-based society and leveraging knowledge and technology for the benefit of the people of Namibia. To achieve that Vision, four Development Plans have been formulated. The NDP4 desired outcome for the ICT sector in is to ensure that by 2017, adequate ICT infrastructure will be in place to facilitate economic competitiveness through innovation, research and development: Availability of latest technologies score improves to 6.0 from 5.5. To this end, the ICT sector developed its Five year Sectoral Plan (2012 -2017) which is cascaded annually to the Annual Sectoral Execution Plan.

The Government of the Republic of Namibia envisaged that by embracing the development of ICT, Namibians will benefit through:

- Access and availability of information that assist them in their daily lives
- Increased competitiveness of business and commerce in the global market place
- Establishment of an environment conducive to the development of Namibian-based ICT providers that are competitive internationally, and create opportunities for employment and economic diversification

The Government of Namibia aims to ensure that every citizen and resident shall have affordable access to high quality information and communication services. To achieve Vision 2030, Namibia

needs to accelerate the use of ICT in Namibia and grow the sector, hence the specific objectives of the ICT policy are:

- To enhance the market and regulatory structure of ICT in Namibia, to fully liberalise (open, competitive market and private sector participation) all telecommunications services by 2010, following a controlled process
- To establish streamlined, efficient and effective regulation of the ICT industry on a fully transparent, technology neutral and competitively balanced basis
- To provide universal access to information and communication facilities in Namibia for all communities (to telephones, Internet and multi-media services) by 2011, by establishing an access point in every community or village.
- To enable affordable prices for telecommunications services, particularly low income groups by 2010
- To enable profitable investment opportunities in all segments of the market by 2010
- To successfully implement government ICT initiatives in education and training by 2013
- To successfully implement e-government initiatives by 2015
- To establish Namibia as a first class regional ICT hub that will contribute towards job creation by 2013

A dedicated Ministry of ICT was established in 2008. Namibia has made good strides in developing the ICT sector. The overarching Information Technology policies include the IT Policy, Broadcasting Policy Communications 2009 and Telecommunications Policy, Postal Policy. The Communications Regulatory Authority of Namibia (CRAN), which was foreseen under the Communications Act of 2009, was operationalised in 2011. National Development Plan 4 (2013/2017) aimed to have “adequate ICT infrastructure in place to facilitate economic development and competitiveness through innovation, research and development” by 2017. As a result CRAN undertook an assessment of current eInfrastructure to develop a plan for necessary ICT infrastructure, digital literacy and supporting ICT-skilled workforce development (CRAN 2014 Annual Report). The Ministry of ICT has been running an annual national ICT Summit since 2014 to bring together the stakeholders who form the ICT value chain to share developments. There is an increased focus on how ICT can be applied to solve national societal challenges and impact on urban, rural and deep rural communities.

The National Policy on Research, Science and Technology was adopted in 1999 and enacted the Research, Science and Technology Act of 2004. They aim to increase coordination, facilitate institutional capacity building, financing of research and development projects and promote science. Both UNAM and NUST developed and approved a Research strategy, which has been revised and developed into a fully-fledged Research Policy for the University together with the Research Ethics Policy.

In 2014, the National Commission on Research, Science and Technology, through a stakeholder consultation process developed Namibia's first National Programme for Research, Science, Technology and Innovation. It prioritises Economic and Social Enablers (Health, Agriculture and Fisheries, Water, Energy, Indigenous knowledge, Social Sciences and Humanities Logistics, Environment and Tourism, Mining and Geosciences) and Technology Enablers (ICT, Manufacturing technologies, Biotechnology).

In 2016, with support from UNESCO, a comprehensive review of the National Policy on Research, Science and Technology (NPRST) of 1999 was undertaken to identify strengths and weaknesses of the National System of Innovation (NSI) and to modernise Namibia's STI policy and invest more proactively in policy implementation. The overall objectives and strategies of this NSTI Policy is to grow Namibia's NSI into a dynamic and strong configuration of public, private, education and research and societal sector institutions that produce, procure, use and govern science, technology and innovation for sustainable development. To achieve these objectives and strategies the NSTIP aims to improve the policy, legislative and regulatory environment; strategic partnerships; scientific and technical competences and infrastructure in Science, Technology, Engineering and Mathematics (STEM).

The focus during the fifth National Development Plan (NDP5), which was launched on 31 May 2017, is to further enhance the use of ICTs in applied research and utilization of research findings. The objective is to ensure that research outputs translate into products and services that address national challenges and priorities. The realisation of objectives set out in Vision 2030, NDP5 and the Harambee Prosperity Plan will focus on key strategies and initiatives to increase access to ICT related services. These strategies and initiatives include providing necessary ICT infrastructure, ICT skills and human resources, modern broadcasting services and increased e-services in an integrated multipronged approach.

12.3 Current ICT Initiatives and projects

ICT Initiatives are currently ongoing at national level in the areas of eEducation (TECH/NA! ICT in Education Initiative, XNet, eLearning Centre (eLC), ICT Centre of Excellence, Namibia-South Africa Joint Calls for Research), eHealth (Integrated Health Care Information Management System) and eGovernment (eInfrastructure, Electronic Voting System, Human Capital Management System, National Population Registration System, Integrated Financial Management System, Integrated Tax Administration systems, Capacity Building, Government Portal, Electronic Documents and Record Management System), Multi-Sectoral community centres, the 081Every1 project, National ICT Summit, Computer Incident Response Team (CIRT).

12.3.1 TECH /NA! , Namibia's ICT in Education Initiative

TECH/NA!, Namibia's ICT in Education Initiative was a comprehensive implementation strategy for the integration of ICTs across the entire education sector blending local expertise and international

support to ensure that all educational institutions are able to efficiently utilize ICTs to meet their overall educational objectives in order to equip, educate and empower administrators, staff, teachers, and learners in ICT literacy and ICT integration skills to help bridge the digital divide with communities and meet the goals of Vision 2030 to fulfil Namibia's ambition to become a knowledge-based society by 2030. It was a sub-programme under ETSIP.

Activities included training of teachers, ICT Literacy and Computer Studies workshops in all 13 regions in the country, and the procurement of ICT equipment for schools, libraries and Teachers' Resource Centres in various regions of the country.

Funding sources: This programme was funded by the Namibian government, with local and international support including funding from EDF10.

Geographic coverage: National

12.3.2 Xnet (National Education and Research Network)

Xnet was initially established in 2003 with a focus on connecting schools. Schools were initially connected with 56k dial-up modems and now 500 schools across Namibia are connected with 1MB lines. In 2007 Xnet extended its services to provide connectivity to all educational institutions. Currently it manages 1GB to provide connectivity to 500 schools, libraries and three universities. While Xnet is a member of UbuntuNet Alliance it has not been able to avail of benefits under the AfricaConnect project due to challenges securing the matching funding required at national level.

12.3.3 eHealth System

The eHealth System, also known as the Integrated Health Care Information Management System (IHCIMS) was launched in 2011 and the system was designed to cater for the day-to-day operational activities and services rendered by hospitals to patients. Medical information of patients will be stored on the Integrated Health Care Information Management System in digital format. Each patient will be given a unique number, which can be used across all 34 government hospitals in Namibia. The system is implemented at Windhoek Central, Katutura and Oshakati hospital. It is necessary to put network infrastructure into some other hospital locations prior to deploying the system.

Funding sources: This programme is funded by the Namibian government, with local and international support

12.3.4 ICT Centre of Excellence

An Information Communications Technology (ICT) Centre of Excellence was established at the University of Namibia in 2011 by Telecom Namibia. The objective of the centre is to promote a culture of excellence in research in telecommunications and information technology, and to create an opportunity for graduates to conduct research in a world class environment. Telecom Namibia

provided information technology specialists to form part of the team that will mould students at the facility. The centre is expected to boost ICT research and development in the country and to narrow the gap between academia and industry in Namibia's Telecommunications, Information and Technology sector. Telecom provided 10 computers, a server, Cisco switches and routers and office equipment. It will also provide at least four research scholarships to promising Namibian masters and doctoral telecommunications and IT students. Telecom also invited MTC and power utilities Nampower and Nampost, to come on board.

Funding sources: This programme is funded by Telecom Namibia and University of Namibia

12.3.5 eGovernance projects

The Namibian government is implementing a number of projects under its e-governance programme. These projects are implemented through the office of the Prime Minister and their coverage spread across the entire public service and are funded by the Namibian government with local and international support. Recently the government launched its eGovernment Strategic Action Plan. The E-Government Strategic Action Plan outlines the tools that need to be promoted by government to make it more accessible and accountable to citizens.

The project was initiated during February 2010 and the first phase of the project assessed the readiness of the Government of Namibia to embark on the e-Governance journey. The survey analysis resulted in the drafting of the Strategic Action Plan, which comprises of programmes and projects at high level. It also outlined the required budget for implementation. The strategic areas that have been identified include the following:

- Impact and Visibility - this will include all those activities that will directly the lives of citizens and increase effective visibility of the government services.
- Collaboration and Networking - this will include all activities that will ensure that e-Government in the country is a truly national effort requiring collaboration and sharing among the different OMAs.
- Consistency and Standardization - this will include all activities that will ensure that e-Government efforts across OMAs are consistent in their approach.
- Training, Education and Research - this will include all activities required to ensure that adequate capacities are created and enhanced among all stakeholders.
- Foundation Support - this will consist of all activities that are required to ensure that all necessary support structures are put in place for the e-Government effort to be successfully run in the country.

Fifteen programmes were outlined in the eGSAP. Ten eGovernment services were identified to be piloted during 2014 - 2018 including an iRecruitment and Employee Self-service process; Processing of permits and civic services; Business registration; Intergrated Tax Administration System; Deeds Registration Process; Issuing of Permits related to Water effluents, plan and animal

import and export and forestry produce; Hunting Permits; Mining Licenses Applications and Renewals; Namibia Students Financial Assistant Fund and eHealth System.

12.3.6 Namibia-South Africa Cooperation - Joint Calls for Research

Within the remit of the bilateral STI Cooperation agreement between Namibia and South Africa, the two countries publish joint calls for research on various thematic areas including ICT. Joint research proposals are submitted to relevant authorities in both countries for review and successful projects are co-funded by both countries. As a result of a joint call, 8 out of 30 projects were funded for the year 2013/14 were in the field of ICT.

12.3.7 Scan-ICT Programme

Namibia is at an advanced stage of implementing the Scan-ICT programme. This is aimed at identifying ICT indicators and build capacity to measure Information Communication Technology for Development (ICT4D). The programme is implemented with a view of harnessing ICTs for development in order to measure the impact of ICTs on various sectors of the economy and citizens. The central scan-ICT portal /database will support policy development and implementation process, with ICTs forming an integral part of the country's vision.

12.3.8 081Every1 project

This project aims to ensure that every Namibian has access to quality networks, mobile connectivity, broadband accessibility and access to information by 2020. MTC intends rolling out services in new areas and improving the current MTC network by installing new towers. Regions are grouped into four clusters. A services will be rolled out in phases over 3 years. The 081 everyone project kicked off in March 2018 with the commissioning of a new network site at Onanke village in Oshikoto region.

12.3.9 Multi-Sectoral Community Centers

Multi-Sectoral Community Centers have been re-named to Rural ICT Centers (RICTCs). They support in bridging the ICT (network coverage) gap between the urban and rural communities, enhance e-government roll-out, ensure ICT equipment and accessories access and usage by remote rural communities.

The Centres provide ICT services such as the provision of Internet access & usage (e.g. windows media center services like photoshop, microsoft office, database access in education, health and agriculture, etc.), basic graphic design services, sound and video editing services, multi-media coverage services, Public Address (PA) System sound services to the rural poor affordably, digital printing, photocopy, lamination and passport photo services and photography.

12.3.10 National ICT Summit

The Ministry of ICT organised the first national ICT Summit in Namibia in 2013. This annual event aims to facilitate the private sector (telecommunications industry, corporates and SMEs) and government to share information about latest ICT trends, examples of how ICT can contribute to socio-economic development and showcase applications and solutions to support good governance and eServices. The fifth ICT Summit took place in Windhoek in October 2018.

12.3.9 Computer Incident Response Team (CIRT)

Namibia is preparing an Electronic Transactions and Cybercrime Bill. In this context the Ministry of ICT started to establish a Computer Incident Response Team (CIRT) in 2017 as a coordinating body to deal with cyber security incidents at national level. The National CIRT Steering Committee developed the CIRT Concept Note outlining the modalities to be established. This preparatory work is ongoing.

12.4 National ICT Research Capacity and Priorities for Cooperation

12.4.1 National Priorities

National ICT Research Priorities include: Digital Content, Technology-enhanced Learning, eGovernment, eHealth, eAgriculture & Fisheries including Water; Entrepreneurship, Mining & Geosciences, Biotechnology, Logistics and Space Science.

Key areas for research cooperation include: Digital Libraries and digital preservation (Indigenous Knowledge), Technology Enhanced Learning; Digital Content; ICT for Environmental Sustainability (Services & Climate Change Adaptation) and Energy Efficiency.

12.4.2 National Research Capacity

The table below provides an overview of universities with ICT/Engineering Course

Institution	Location	Total Students	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Post-Graduate Programmes (Masters)
University of Namibia	Windhoek	13,000	Department of Computer Science	13	Masters of Science - Information Technology
	Ongwediva		Engineering and Information Technology	8	-
Namibia University of Science and Technology	Windhoek	1,100	Faculty of Computing and Informatics, Faculty of Engineering, Faculty of Natural Resources and Spatial	46	Masters in Information Technology
International University of Management	Windhoek	696	Information Technology and Systems Management	27	

Research in Namibia is predominately carried out within the two main Higher Education Institutions:

➤ **University of Namibia**³³¹

- Depts include: Faculty of Engineering & Information Technology - Department of Electronics and Telecommunication Engineering; Faculty of Health Sciences; Faculty of Agriculture; Multidisciplinary Research Centre - Science, Technology, Innovation Division & Social Sciences Division
- Research areas include:
 - Health - Research on malaria elimination, Epidemiology and active case detection of malaria in Engela district;
 - Faculty of Science - Bio prospecting of Namibian ethno botanicals for anti-HIV activities, Application of biotechnology towards conservation of different Namibian endangered species, Application of semi martingales to finance;
 - SANUMARC - Aerosol robotic network group, Scientific committee on Oceanic Research, Spaces programme;
 - Domestication of marama beans, Mixed cropping or intercropping of drought adapted pearl millet, sorghum and other crops with the flood adapted rice crops (ogongo);
 - Faculty of Agriculture and Natural Resources - Community Conservation Fisheries in KAZA Project (EU funded project), Impalila Tourism Fisheries Management of the Kasaya Channel, Sikunga Conservancy Tourism Fisheries Management (MCA funded projects), Development of a Fisheries Management Plan for the Okavango River (SAREP funded project), Improved Knowledge of Aquatic Knowledge Systems supporting Fisheries, Development of Integrated Strategies for Sustainable Fisheries and Improved Fisheries Management (SASSCAL funded project), Zoobenthos Survey in the Walvis Bay (Walvis Bay Municipality funded project)

➤ **Namibia University of Science and Technology (NUST)**³³²

- Depts include: Faculty of Computing and Informatics, Faculty of Engineering, Faculty of Natural Resources and Spatial
- ICT Research Groups include: 7 Clusters: Indigenous Knowledge Management Systems (IKMS), Dependable Advanced Network Systems (DANS), Marginalised Community Development (MCD) including Virtual and Augmented Reality systems for Museums (heritage) and Entertainment systems, Smart Communication Systems (SCS), Digital Forensic & Information Security (DFIS), E- Participation (EP), Business & Policy Analytics

³³¹ <http://www.unam.na/>

³³² <http://www.polytechnic.edu.na/>

(BPA), Focus Areas include: Big Data, Indigenous Knowledge, SMart and Secure Environments, Digital Transformation

➤ Research areas include:

- School of Information Technology - Community-centred localisation; Mobile Futures Lab; Mobile Content and Applications for Entrepreneurship Development; Forensic Computing and Security Research Group; Health Informatics Research Cluster; Mobile Sensor Data Processing
- School of Engineering - Renewable Energy and Energy Efficiency; Water Resource Management; Manufacturing Systems; Mining Sustainability and Environmental Impact; Windhoek and its Environs-Architectural Perspective
- School of Health and Applied Sciences - Health and medical sciences research
- School of Natural Resources and Tourism - Development and application of spatial technologies and appropriate tools; Ecosystems services and biodiversity; Land, Agriculture and Water; Wildlife and Tourism
- School of Economics and Finance - Managing implication on the use of technology in higher learning institutions; Analysing the socio-economic impact of investing pensionable funds in economic development activities; A small macro-econometric model for Namibia
- School of Humanities - Exploring Agency for survival during a crisis; Bridging the gender gap: African feminism; Conflict management
- Centre for Cooperative Education - Human Resource Development (Pedagogy and e-portfolio development); National Strategy/Policy for Cooperative Education
- Renewable Energy and Energy Efficiency Institute - Low Cost National Wind Resource Assessment in Namibia; Investigating the Effectiveness of Introducing Energy Shops; Solar Power; Improvement of Regulations; Auditing and Energy Marketing Services; Green Rating Tools; Techno-socio-economic Survey of Energy Efficiency; Energy System Model for Namibia; Regulatory Framework for Renewable Energy Procurement Processes

➤ **International University of Management (IUM)**

- Depts include: Faculty of Information Technology & Systems Development (ITSD), Software Development Department (SDD), Network & Security Department (NSD), Information Technology Department (ITD)

12.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and additional information collected during the IST-Africa Horizon 2020 Training Workshop in October 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners
eHealth / mHealth	Health Information Systems/Electronic Health Records; Mobile Applications to support reproductive health; Mobile applications to educate youth on health issues	University of Namibia (School of Medicine); Namibia University of Science and Technology (School of Health and Applied Science); Ministry of Health; International University of Management
eAgriculture	Mobile Applications for farmers - animal tracking, tips on livestock and crop production	University of Namibia (Faculty of Agriculture and Natural Resources); Namibia University of Science and Technology (School of Natural Resources and Spatial Sciences), Ministry of Water, Agriculture & Forestry (Directorate of Research & Training)
Technology-enhanced Learning	Distance Learning and eLearning solutions; Mobile and game applications for mathematics learning	University of Namibia; Namibia University of Science and Technology; International University of Management
eGovernment	Public Service Delivery	University of Namibia; Namibia University of Science and Technology

12.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Future Internet	Namibia University of Science and Technology (School of Information Technology): Cloud Computing, Cyber Security, Privacy and Trust, Immersive Interactive Multimedia and Connected Enterprise
Content Technologies & Information Management	Namibia University of Science and Technology (School of Information Technology): Learning, Interaction, Digital Preservation, Content Access and Analytics; Big Data Technologies' Advanced Data Mining, Machine Learning

	International University of Management: Technology-enhanced Learning
Robotics	University of Namibia (SANUMARC): Aerosol robotic network group
Components and Systems	Namibia University of Science and Technology (School of Information Technology): Technologies for IoT, Smart Integrated Systems,
Key Enabling Technologies: Micro - Nano- electronics and Photonics	Namibia University of Science and Technology (School of Information Technology): Design, Production Technologies and Demonstration Actions to Validate Technology Developments and Innovative Business Models

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	University of Namibia (Faculty of Health Sciences): Malaria Namibia University of Science and Technology (School of Health and Applied Sciences): eHealth and mHealth International University of Management (School of Health Science)
Food Security, Sustainable Agriculture	University of Namibia (Faculty of Agriculture and Natural Resources): Crops, Fisheries Management Namibia University of Science and Technology (School of Natural Resources and Tourism): Ecosystems services and biodiversity, Land, Agriculture, Water
Energy	University of Namibia (School of Engineering): Renewable Energy Namibia University of Science and Technology (Renewable Energy and Energy Efficiency Institute): Wind Resources, Solar Power, Green Rating Tools, Energy Efficiency
Climate Action, Environment, Resource Efficiency and Raw Materials	University of Namibia: Water Management Namibia University of Science and Technology (School of Engineering): Protection of Environment, Sustainable Management of Natural Resources, and Ecosystems
Inclusive, Innovative and Reflective Societies	Namibia University of Science and Technology (School of Information Technology): Indigenous Knowledge in relation to Cultural Resources University of Namibia: eGovernance
Secure Societies	Namibia University of Science and Technology

	(School of Information Technology): Cyber Security and privacy
Secure, Clean and Efficient Energy	Namibia University of Science and Technology: Smart cities;

Level of Research Maturity

Namibia like Botswana is a middle-income country also trying to diversify its economy and attract foreign direct investment. Namibia is gradually increasing the focus on research and started to build an international track record in collaborative research through participation in **11** FP7 projects.

Up to September 2018, Namibian organisations have been involved in 7 Horizon 2020 projects with research funding in excess of €580,000 across a number of thematic areas:

- SOCIETY, H2020-INT-INCO-2014 - **RINEA** (National Commission for Research Science and Technology)
- H2020-MSCA-RISE-2014 - **PARTY** (MSCA-RISE) - Polytechnic of Namibia
- H2020-SC5-2015-one-stage - **HiTech AlkCarb** (RIA) Geo-Africa Prospecting Services Cc; A. Speiser-Environmental Consultants Cc
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA) - (National Commission for Research Science and Technology)
- H2020-INFRA-SUPP-2016-1 - **SEACRIFOG** (CSA) - Southern African Science Service Centre for Climate Change and Adaptive Land Management
- H2020-MSCA-ITN-2017 - **ANTHUSIA** (MSCA-ITN-EJD) - Legal Assistance Centre
- H2020-MSCA-ITN-2017 - **POEM** (MSCA-ITN-ETN) - Namibia University of Science and Technology

There is a commitment to strengthen the research capacity within the country, and especially in facilitating the continued development of post-graduate programmes and involvement in cross-border research.

The University of Namibia and Namibia University of Science and Technology are the primary research institutions in Namibia. An Information Communications Technology (ICT) Centre of Excellence was established at the University of Namibia in 2011 by Telecom Namibia. The centre is expected to boost ICT research and development in the country and to narrow the gap between academia and industry in Namibia's Telecommunications, Information and Technology sector.

Namibia has launched a number of Joint Calls for Research focused on a number of themes including ICT with South Africa under their bilateral Science Technology and Innovation Agreement since 2011.

12.5 Innovation Spaces

Innovation Spaces within Higher Education Institutions include: the *FABlab Namibia Technology Centre*³³³, which was established as a Centre of Excellence within the Namibia University of Science and Technology (NUST) in 2014 (part of a MIT originating network of innovation spaces); *Innovation Design Lab*³³⁴ at NUST; *Namibia Business Innovation Institute (NBII)*³³⁵ at NUST and its Mobile Lab³³⁶ and *Global Business Labs Namibia*³³⁷ which is hosted by the University of Namibia and supported by the Finnish government funded regional SAIS Programme since 2013 to provide Acceleration services. The *Bokamoso Entrepreneurial Centre* (previously established as the Windhoek SME Incubation Centre) provided Incubation services and cooperated with FemTech Programme supported by SAIS Programme. The National Commission on Research, Science and Technology set up an Innovation Hub in Windhoek in 2016, which leverages the Demola model³³⁸.

The Namibia University of Science and Technology hosts three Innovation Spaces: *FABlab Namibia Technology Centre*, *Innovation Design Lab* and *Namibia Business Innovation Institute (NBII)*. The *FabLab Namibia Technology Centre* is an advanced manufacturing, prototyping and design lab to support local communities, entrepreneurs and artisans to develop technological solutions to solve local problems. It was set up through a partnership with the Ministry of Industrialisation, Trade and SME development, GIZ (Germany Federal Government) and NUST. Following visits to FabLabs in Kenya and South Africa funded by the Finnish Southern African Innovation Support Programme (SAIS) in 2012, FabLab Namibia Technology Centre commenced activities in 2014. MTI provided funding of N\$7 million to fund the start up and equipment and GIZ provided funding of N\$2.2 million towards the building and provided advice. FabLab provides access to equipment and training, design and prototyping services (including 3D printing), consultancy services and rental space.

The Innovation Design Lab is multi-disciplinary research centre. Current projects focus on solar energy water desalination and a solar utility vehicle. Students with NUST have the opportunity to participate in these research projects.

The *Namibia Business Innovation Institute (NBII)* was initially set up in 2009 as a centre of excellence at the Polytechnic of Namibia (then known as the Namibia Business Innovation Centre (NBIC)) Its activities focus around Innovation Marketplace (events to support entrepreneurial activities), Entrepreneurship and Incubation (Bootcamp - business plan writing workshops, Mentorship and market research workshops) and Research and Development (Mobile Labs and RLabs Namibia). The Polytechnic of Namibia (now known as the Namibia University of Science and Technology – NUST) also hosts the Mobile Lab, which provides a platform supporting students and

³³³ <http://www.fablabnamibia.org/>

³³⁴ <http://www.nust.na/?q=centres/innovation-design-lab/about-idl>

³³⁵ <http://nbii.nust.na/>

³³⁶ <http://nbii.nust.na/?q=mobile-lab>

³³⁷ www.globalbusinesslabs.com/office/namibia/

³³⁸ <https://namibia.demola.net/>

professionals to develop localised mobile applications that address local community needs. NUST also hosted the ICT for Development Living Lab”

Global Business Labs Namibia was established in February 2013 in partnership with the University of Namibia. Primarily targeted at students and alumni, following screening four times a year, entrepreneurial teams are accepted in to the GBL accelerator program which provides access to co-working space, coaching and training, mentoring, networking and professional services from knowledge partners for 8 – 12 months. Regular lectures and networking events are organised.

The National Commission on Research, Science and Technology (NCRST) set up an *Innovation Hub* in Windhoek in 2016. It leverages the Finnish Demola model to support co-creation of projects undertaken by students and researchers over 3 months based on challenges provided by organisations from both the public and private sectors. It has organised a number of pitch events and events to showcase solutions developed.

NCRST is the focal point in the Southern African Innovation Support Programme (SAIS 2), which is supported by the Ministry of Foreign Affairs Finland from 2017 - 2021. The SAIS2 Innovation Fund provides grants for locally implemented projects with partners from the beneficiary countries (Botswana, Namibia, South Africa, Tanzania and Zambia). NCRST is a member of the SAIS2 Connected Hubs.

Founded in 2003, the *Bokamoso Entrepreneurial Centre* in Windhoek provides incubation and co-working space for startups and early stage companies in the fields of crafts and jewellery making, clothing manufacturing, joinery and carpentry and innovative/solar businesses. The incubation programme includes counselling, ongoing mentoring, facilitation of business linkages, training and business seminars and access to IT. Discounted work space is provided for a maximum of 3 years.

13. REPUBLIC OF SENEGAL

13.1 Introduction

Senegal is the most advanced Western African country along the Atlantic Ocean, with major sea and air routes to Europe, other African countries and the Americas.

Covering an area of 196,722 km², it is bordered on the north by Mauritania, east by Mali, south by Guinea and Guinea Bissau, west of the Gambia and a coastline along the Atlantic Ocean for 500 km. Senegal is a flat country with sandy soil not exceeding 130m except at the south-eastern border of Republic of Guinea. Three rivers cross the country from east to west: Senegal (1700 km) north, Gambia (750 km) and Casamance (300 km) south. Senegal consists of 14 administrative regions: Dakar,



Diourbel, Fatick, Kaffrine, Kaolack, Kedougou, Kolda, Louga, Matam, Saint-Louis, Sedhiou, Tambacounda, Thies and Ziguinchor. The population as at July 2018 was estimated at 15.02 million inhabitants, with a literacy rate of 57.7% (CIA World Factbook). Fifty five percent of the total population is between 15 and 64 years of age. Dakar (550 km²), the capital, is a peninsula in the far West with a population of 3.63 million (ANDS Report 2018). The official language is French, with English being used in business. The national languages include Diola, Malinke, the Pular, Serer, Soninke and Wolof.

The Republic of Senegal is a secular, democratic and social country. It ensures equality before the law for all citizens, without distinction of origin, race, sex or religion. GDP is primarily driven by services, industry and agriculture. Its natural resources include: petroleum, gas, iron ore, zircon and gold.

Senegal has a good telecommunication infrastructure and Internet access is cheaper than in other African countries. International bandwidth for Internet access is currently 12.4Gbps. There are 3 mobile providers (Orange, Tigo and Expresso). According to figures published by L'Autorite de Regulation des Telecommunications et des Postes (ARTP), as at September 2018 there were 299,774 fixed phone lines (287,980 September 2017) and 16.403 million mobile phone subscriptions (15.556 million September 2018) with mobile penetration at 107.52%. There were 10.447 million Internet subscribers as at September 2018 compared with 9.354 million in September 2017. The major of Internet users are mobile Internet users (2G & 3G) with 17,961 fixed internet lines, 130,612 ADSL lines and 115,978 mobile internet key users as at September 2018.

In terms of ICT Infrastructure, three submarine cables (Atlantis 2, SAT3/WASC/SAFE and Africa Coast) connect Senegal to the rest of the world. The national backbone is under construction. All

regions and Departments in Senegal are connected via optical fibre. The Senegal Internet Exchange Point (SENIX) was launched on 29 August 2017.

There are six public Universities (Université Cheikh Anta Diop de Dakar, Université Gaston Berger de Saint-Louis, Université de Thies, Université Alioune B. Diop de Bambey, Université de Ziguinchor and Université Virtuelle du Sénégal), two more under construction where courses will start in 2018 (Université Amadou Mahtar Mbow de Diamniadio and Université du Sine Saloum El hadji Ibrahima Niass), seven private Universities, six public Institutes or Schools of Higher Education and 141 private Higher Education Institutions.

13.2 ICT Background

The Government of Senegal wishes to make Senegal a regional leader in the production of value-added services supported by ICT, in order to improve its position in the global economy. To achieve these objectives, Senegal has developed a multitude of programs related to Information Technology and Communication (ICT). In fact, for over two decades, State Authorities have considered ICT as an essential part of development.

Since 2000 a national strategy for developing ICT was defined and a State Computer Science Bureau and Ministry responsible for ICT has been established.

ICT is used widely in secondary and third level institutions. There is good interconnection in Government and administration buildings to facilitate the provision of services. The Universal Service Fund considers Internet and telephony to be an integral part of a universal service.

After strengthening the infrastructure, the Senegal authorities prepared the legislative and regulatory component of new technologies to create a legal environment favourable to their development. The first step was the establishment by law No. 2001-15 of December 27, 2001, as amended, of the Code of Telecommunications and the Regulatory Agency for Telecommunications and Posts (ARTP) responsible for providing the telecommunications sector with an effective and transparent regulatory framework, promoting fair competition to the benefit of users of telecommunications networks and services.

Another key step in the mentoring process of ICT development in Senegal was the creation of the State Information Technology Agency (ADIE). Decree N° 2004-1038 of 23 July 2004 mandates ADIE to stimulate public action in the treatment and dissemination of information in accordance with international legal and technical standards for quality, availability, safety and performance. For this purpose, ADIE launched a process that led to the adoption of appropriate laws and regulations in 2005.

Several laws were adopted and promulgated.

- Law No. 2008-10 of January 25, 2008 on orientation law on information society
- Law No. 2008-08 of January 25, 2008 on electronic transactions

- Law No. 2008-11 of January 25, 2008 on Cybercrime
- Law No. 2008-12 of January 25, 2008 on the protection of personal data
- Law No. 2008-49 of September 23, 2008 establishing a voluntary contribution of one percent (1%) on public procurement of goods and digital services
- Law No. 2008-46 of September 3, 2008 establishing a royalty on access or use of public telecommunications network (RUTEL)
- Law No. 2008-41 of August 20, 2008 on cryptology.

The Privacy Protection Commission (CDP) is an Independent Administrative Authority (IAA) established under Law No. 2008-12 of 25 January 2008 on the protection of personal data.

2011 marked the adoption of a telecommunication code implementing most of the directives adopted by the Economic and Monetary Union of West Africa (UEMOA) and additional acts that the Treaty of the Economic Community of African States (ECOWAS) to create a legal environment conducive to the emergence of a regional market.

A National Commission of Cryptology, attached to the General Secretariat of the Presidency of the Republic, and whose permanent secretariat is provided by the Central Technical Services of Numbers and Security of Information Systems (STCC) was established.

The "Senegal Digital 2025" strategy was drawn up on the basis of the orientations set by the PES. It embodies Senegal's ambition to maintain an innovative leading position in Africa in the digital field. It consists of three prerequisites and four priority axes articulated around the slogan "the digital for all and for all uses in 2025 in Senegal with a dynamic and innovative private sector in an efficient ecosystem".

13.3 Current ICT Initiatives and projects

ICT Initiatives are currently ongoing at national level in the areas of eGovernment (eSenegal, Universal Service Fund, Social Impact of ICT in Senegal), eInfrastructures (SeniX, SnRER Education and Research Network, Senegal Observatory on Information Systems, Networks and Info highways), Research (Centre de Recherche et d'Essai Programme, Scan ICT project), Entrepreneurship (CTIC Dakar ICT Incubator) and eEducation (Virtual University of Senegal with 50 ENO "Open numeric space"). Previous projects included the Multimedia Community Centres Programme (2011 - 2013), Grid Computing project, Brain Gain Initiative, Migration from Analogue to Digital Broadcasting project. The five Universities in Senegal and Senegal and the Polytechnic university of Thiès are subscribers to Elsevier. They can access Science Direct, Scopus, Masson and Cairn data repositories.

13.3.1 E-Senegal: E-government from Senegal and ICTs at the service of citizens

E-Vision Senegal aims to put the citizen and business concerns within the government, to allow all citizens to access information, to meet the performance needs of the State and actionable information officers.

The following priorities are addressed:

- the development of communications infrastructure linking all government departments
- setting up a government information system integrating the various information sources of the administration
- definition of organizational entities responsible for managing the IT policy

Results include:

- Interconnect by WIMAX 665 administrative building located in 35 departments
- Local Network (LAN) in all 665 buildings using WiFi or Ethernet.
- Videoconference platform between 14 regions
- Interconnection of universities and research centres
- Data centre building

Funding: Senegal, China (intranet), Korea (wimax), France (demarches administratives)

Geographic coverage: National

13.3.2 Universal Service Fund

The major objectives of the Universal Service Fund are to:

- bridge the access gap in networks and telecommunications services (telephone and Internet) throughout the national territory by 2012;
- promote the economic and social development of rural populations and those in disadvantaged areas through the provision of appropriate ICT applications;
- expand access to the Internet via broadband infrastructure to shared resources in social projects and Community as the interconnection of academic, health institutions and schools, facilities, etc.
- promote the creation of knowledge communities in the territory, relying in particular on the government infrastructure and public or private initiatives.

The new fund for the development of universal telecommunications service (FDSUT) was initiated with ICTC (ICT growth Accompanist) as a competition to awaken the creative genius of young Senegalese entrepreneurs who are active in ICT.

Funding: Telecommunications operators

Geographic coverage: National

13.3.3 Social Impact of Information Technology Communication in Senegal

This project is focused on development of mobile payments, Internet use in the campaign and Interconnection of all government infrastructures (fixed telephone, mobile, Internet). The United Nations Research Institute for Social Development (UNRISD) is an autonomous research institute within the UN system that undertakes multidisciplinary research and policy analysis on the social dimensions of contemporary development issues. ADIE aimed to reduce the phone bill of the state in half during 2014, from 22 to 11 billion CFA francs

Implementing department: UNRISD

Geographic scope and time frame: National; ongoing.

13.3.4 Senegal Internet Exchange Point (SenIX)

Initial planning for the Senegal Internet Exchange point commenced in 2015 with support from ADIE and ARTP (regulator). Over the past two years further support was provided through the AXIS project in the context of supporting the establishment of Internet infrastructure in Africa and national and regional internet exchange points. SenIX was launched on 29 August 2017. It will support exchange of internet traffic between service providers, optimise use of bandwidth and over time reduce access costs for consumers in Senegal.

13.3.5 SnRER Education and Research Network Initiative

The main goal of SnRER is to build a national and regional academic infrastructure to:

- Support research and science collaboration;
- Build a common information system and data center for higher education in the country;
- Share resources and applications: grid-computing, e-learning, VoIP, videoconference, digital library, e-health, etc.
- Connect to other regional or international academic network (WACREN, GEANT, INTERNET2, etc.)

SnRER has made a lot of progress since its establishment by the Ministry of Higher Education and Scientific Research and its mandate to host the regional NOC by WACREN in March 2011. In April 2011 training and capacity building was undertaken in collaboration with NSRC and the University of Oregon. During April – July 2011, the campus network for 5 public universities was designed. During 2015 all five public universities (Université Cheikh Anta Diop de Dakar, Université Gaston Berger de Saint-Louis, Université de Thies, Université Alioune B. Diop de Bambey and Université de Ziguinchor) are interconnected via optical fibre. All Public University Campuses have free Wifi Internet access. Internet access is available in all pedagogical and social campus with bandwidth of 2 x 155MB.

SnRER is a beneficiary of AfricaConnect II via WACREN.

Geographic scope and time frame: National; ongoing.

13.3.6 Centre de Recherche et d'Essai (CRE) Programme

CRE are units of development of research based on the promotion and the provision of means of applications of scientific and technological innovations for well-being. They provide an interface between citizens and the R&D sector and use ICT as a main activity. Thirty research centres were installed by October 2018.

Implemented by the Ministry in charge of Scientific Research & Higher Education and Innovation³³⁹

Funding source: Government of Senegal

Geographic coverage: National

13.3.7 Senegal Observatory on Information Systems, Networks and Info highways (OSIRIS)³⁴⁰

Established in March 1998 by a group of people working in the private sector, higher education, administration and associations, the Observatory on Information Systems, Networks and Info highways Senegal (OSIRIS) is a non-profit association.

OSIRIS raises awareness, informs and provides analysis on all matters relating to the use and appropriation of Information Communication Technology and more generally on the development of Information Society in Senegal and Africa.

OSIRIS has the following objectives:

- Contribute to the development of the Information Society based in particular on the recommendations of the Initiative African Society in the Age of Information adopted by the United Nations Economic Commission for Africa;
- Promote the use and ownership of information technology and communication;
- Identify all initiatives in information technology and communication and to encourage synergies;
- Inform policy makers of different sectors such as private citizens on the opportunities and issues related to information technology and communication;
- Promote international cooperation in general and sub-regional in particular in the field of information technology and communications.

³³⁹ www.recherche.gouv.sn

³⁴⁰ www.osiris.sn

13.3.8 CTIC Dakar: An ICT Incubator³⁴¹

CTIC Dakar was opened in March 2011 to assist ICT companies, Information Technology and Communication, as well as project leaders, in their stages of creation, development and growth. It offers businesses and to project the ICT infrastructure and services necessary to ensure sustained growth and sustainable. CTIC Dakar is an example of Public Private Partnership led by the ICT Incubators Foundation of Senegal (FICTIS). Partners and sponsors include both public and private international organizations.

13.3.9 E-ICT project³⁴²: projects related to agriculture and livestock in the Sahel region

The E-ICT project is a multi-stakeholder initiative coordinated by the ICVolunteers organization. The project is being implemented in Senegal and Mali (Sahel region), with support from Francophone Information Highway Fund and a range of other partners.

Objectives:

- Develop training in ICT for better farm business management;
- Raise awareness about a better management of pastoralism and health issues;
- Promote the adoption of practices focused on the sustainable development farming through a better accountability of breeders including an awareness of environmentally friendly agriculture and biodiversity;
- Promote the use and marketing of products and by-products of farming;
- An inventory and the establishment of a monitoring system of animals and pasture, interface "Green Network";
- Enhance food security

13.3.10 Scan ICT Project (IDRC)

Scan-ICT is an activity carried out by the Research Centre for International Development Research Centre (IDRC) in collaboration with the United Nations Economic Commission for Africa (ECA). This is an ambitious proposal with long-term aims to mobilise the support needed to create a phased comprehensive African capability to collect and manage key information needed to support investment increasingly important technologies information and communication technologies (ICT) to help African countries become an Information Societies.

Implementing department: IDRC, UNECA

Geographic scope and time frame: National; ongoing.

³⁴¹ www.cticdakar.sn

³⁴² www.e-tic.net

13.3.11 Senegal Virtual University

The Ministry of Higher Education and Research established the Senegal Virtual University to facilitate efficient and accessible Higher Education through a digital open space in each Department in the country. UVS has become the second largest university in Sénégal with 19,000 students behind University Cheikh Anta Diop of Daka. 13 open numeric spaces (ENO) are functional with 50 planned.

Geographic scope and time frame: National; ongoing.

13.4 National ICT Research Capacity and Priorities for Cooperation

13.4.1 National Research Capacity

Senegal has seven public institutions of higher education:

- Université Cheikh Anta de Dakar³⁴³
- Université Gaston Berger de Saint-Louis³⁴⁴
- Université de Thiès³⁴⁵
- Université Alioune DIOP de Bambey³⁴⁶
- Université Assane Seck de Ziguinchor³⁴⁷
- Université Virtuelle du Sénégal
- Ecole Polytechnique de Thiès³⁴⁸

and the main research laboratories in Senegal are located in two universities:

1. Université Cheikh Anta Diop de Dakar

- a. Laboratoire d'Imagerie Médicale et de Bio-informatique
- b. Laboratoire d'Informatique, Réseaux et Télécommunications (LIRT)
- c. Laboratoire de Traitement de l'Information (LTI)
- d. Mathématiques de la Décision et d'Analyse numérique
- e. Equipe de Cryptologie
- f. Equipe de Codage
- g. Equipe Réseaux, Services et Télécommunications

³⁴³ <http://www.ucad.sn/>

³⁴⁴ <http://www.ugb.sn/>

³⁴⁵ <http://www.univ-thies.sn>

³⁴⁶ <http://www.bambey.univ.sn/>

³⁴⁷ <http://www.univ-zig.sn/>

³⁴⁸ <http://ept.sn/>

2. Université Gaston Berger de Saint-Louis

- a. Laboratoire d'Analyse Numérique et d'Informatique (LANI)
- b. Laboratoire d'Électronique, Informatique, Télécommunications et Énergies Renouvelables (LEITER)

Two public universities are under construction and will commence courses in 2018 (Univertité Amadou Mahtar Mbow de Diamniadio and Université du Sine Saloum El hadji Ibrahima Niass).

13.4.2 ICT-39 Priority Themes

Based on consultation with stakeholders the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Partners include
eHealth	Université Gaston Berger; Université Cheikh Anta Diop
Environment	Université Cheikh Anta Diop; Ecole Polytechnique de Thiès; Ecole Supérieure Polytechnique de Dakar-UCAD

13.4.3 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Advanced Computing	Université Cheikh Anta Diop: Sensors
Future Internet	Université Gaston Berger: Networking
Content Technologies & Information Management	Université Gaston Berger: Language Technologies, Semantic Web, Intelligent Technology Université de Bambey: Information Management Universite de Ziguinchor: Information Management Université Cheikh Anta Diop: Technology-enhanced Learning & Digitisation Université Gaston Berger: Digital processing & Digitisation Ecole Supérieure Polytechnique de Dakar-UCAD: Technology-Enhanced Learning
Robotics	Université Cheikh Anta Diop: Robotics

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	Université Gaston Berger: Mathematical models for eHealth Université Cheikh Anta Diop: Image processing - eHealth
Climate Action, Environment, Environment, Resource Efficiency and	Université Cheikh Anta Diop: Water Management and Sensors

Raw Materials	Ecole Polytechnique de Thiès: Water Management Ecole Supérieure Polytechnique de Dakar-UCAD - Energy efficient design & solar energy
Inclusive, Innovative and Reflective Societies	Ecole Polytechnique de Thiès: Cultural resources
Secure Societies	Ecole Polytechnique de Thiès: Trustworthy ICT

Level of Research Maturity

Senegal has a good research base and track record in collaborative research through participation in more than **41** projects securing over **€5.3 million** in research funding under FP7.

Up to September 2018, Senegal has been involved in 22 Horizon 2020 projects with research funding in excess of €2.78 million across a range of thematic areas:

- LEIT-SPACE, H2020-Galileo-2014-1 - **MAGNIFIC** (Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar)
- FOOD, H2020-SFS-2014-1 - **PROIntensAfrica** (Conf. Respons. Recher. Agronom.Afriq. de L'Ouest & du Centre)
- HEALTH, H2020-Adhoc-2014-20 - **REACTION** (Université Cheikh Anta Diop de Dakar)
- LEIT - ICT-39-2015 - **WAZIUP** (Uni of Gaston Bergege de Saint Louis, CODER4Africa, CTIC Dakar)
- H2020-Galileo-2015-1 - **GRICAS** (Agence Pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar)
- H2020-INT-SOCIETY-2015 - **EUNPACK** (Alliance pour Refonder la Gouvernance en Afrique Arga)
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (Ministère de la Recherche Scientifique)
- H2020-SC1-2016-RTD-Zika - **ZikaPLAN** (Institut Pasteur de Dakar); ZIKAlliance (Institut Pasteur de Dakar)
- H2020-SFS-2016-1 - **LEAP-AGRI** (Ministère de la Recherche Scientifique)
- H2020-INFRAIA-2016-1 - **INFRAVEC2** (Institut Pasteur de Dakar)
- H2020-JTI-IMI2-2014-02-single-stage - **EbolaMoDRAD** (Institut Pasteur de Dakar)
- H2020-MSCA-RISE-2015 - DEMOSTAF (MSCA-RISE) - Agence Nationale de la Statistique et de la Démographie; Université Assane Seck de Ziguinchor; Université Cheikh Anta Diop de Dakar
- H2020-SFS-2016-2 - FarFish (RIA) - Conservation and Research of West African Aquatic Mammals (Corewam); Institut Sénégalais de Recherches Agricoles
- H2020-SFS-2016-2 - PALE-Blu (RIA) - Institut Sénégalais de Recherches Agricoles
- H2020-MSCA-RISE-2016 - SLAFNET (MSCA-RISE) - Université Cheikh Anta Diop de Dakar

- H2020-MSCA-RISE-2016 - Iucn - PADDLE (MSCA-RISE) - Senegal and Universite Cheikh Anta Diop De Dakar
- H2020-GALILEO-GSA-2017-1 - GRIMASSE (IA) - Agence pour la Securite de la Navigation Aerienne en Afrique et a Madagascar
- H2020-EO-2017 - NADIRA (IA) - Manobi Senegal - SA
- H2020-ICT-2017-1 - WAZIHUB (IA) - Sonatel - Sa; Universite Gaston Berger de Saint Louis
- H2020-LC-SC3-2018-Joint-Actions-1 - PRE-LEAP-RE (CSA) -Agence Nationale pour les Energies Renouvelables
- H2020-SFS-2018-1 - LEAP4FNSSA (CSA) - Ministere de la Recherche Scientifique

There is an increasing emphasis on further strengthening the research capacity within the country, and facilitating the continued development of post-graduate programmes and involvement in cross-border research.

13.5 Innovation Spaces

Innovation Spaces include MobileSenegal Hub³⁴⁹, which was established as a virtual tech hub in 2008 to support training in mobile technology; Jokkolabs³⁵⁰ which was established as a co-working space in 2010, followed by JokkoFabLab³⁵¹ and Jokko Labs Saint-Louis³⁵²; CTIC Dakar³⁵³, which was established in 2011 as a tech hub providing Pre-Incubation and Acceleration Services in West and Central Francophone African countries; and Jjiguenetech Senegal³⁵⁴, which was established as the first technology incubator in Senegal for women. Both JokkoLabs and CTIC Dakar are members of AfriLabs.

Established in 2008 with support from Pace University in the US, **MobileSenegal** (now established as the Mobile4Senegal association) was the first Francophone mobile focused incubator in Africa. MobileSenegal focuses on training mobile developers - to date, over 450 participants have completed boot camps and competitions and developed more than 70 applications. To date, grant funding has been provided through Pace University (Google, NCIIA, IBM), and local companies.

Established in April 2011, **CTIC Dakar** is primarily focused on supporting high growth potential ICT entrepreneurs with support from the Government of Senegal, the Telecoms regulator, Orange, World Bank, GIZ and the European Union (Centre for the Development of Enterprise – CDE). CTIC Dakar provides hands-on-business development support and coaching for entrepreneurs, as well as training on financial and communication issues, organises events for young entrepreneurs and has also established in six month duration accelerator program for high potential impact startups. 25%

³⁴⁹ <http://mobilesenegal.org>

³⁵⁰ <http://jokkolabs.net/en>

³⁵¹ <https://www.fablabs.io/defaralsalabo>

³⁵² <http://saintlouis.jokkolabs.net>

³⁵³ www.cticdakar.com

³⁵⁴ <http://jjiguenetech.com>

of operating costs are contributed by companies supported (through revenue growth sharing), with 30% grant funding, 25% sponsorship and 20% through delivery of business development services. CTIC Dakar is a partner in the WAZIUP Horizon 2020 project focused on IoT.

Established in October 2010, **Jokkolabs Dakar** is part of a network of six co-working spaces in Mali, Burkina Faso, Senegal and France. Specifically focused on addressing social needs in Agriculture, Health, Governance and Primary School Education, leveraging open source is part of its culture.

Established by women in 2012, **JJiguene Tech Senegal** is the first woman's tech Hub in Senegal. It has the objective of encouraging, inspiring and training more women in the tech ecosystem in Senegal through networking, training, mentoring and sharing knowledge. It also aims to increase the number of women in technology and entrepreneurship by encouraging more girls to take STEM (Science, Technology, Engineering and Maths) subjects in school and university. Pre-incubation space is provided, with an emphasis on businesses with high social potential impact. JJiguene Tech Senegal organises monthly meetings, school and university outreach programs, a mentorship program and ICT and entrepreneurial skills training for girls between the ages of 13 – 25.

The ISEG research group at Université Internationale des Diasporas Africaines (UNIDAF) was responsible for establishing the African Living Lab, which focused on developing a network of laboratories across West Africa to promote technology takeup and digital community by youth.

Established in 2011, HubSocial focused on developing social solutions for Senegal and West Africa, and how ICT can be leveraged to address poverty reduction, health and education. While the Indigo Trust found its work interesting, it no longer appears to be active.

The work of the Senegal Chapter of Coders4Africa has helped strengthen the innovation ecosystem through the number of individuals who have been enabled to develop technology. Students have created apps addressing societal challenges in areas including health, agriculture and education.

The innodev incubator at Ecole Supérieure Polytechnique, Université Cheikh Anata DIOP provides office space, equipment and business mentoring. Three FabLabs were set up within the Engineering Schools of ESP, EPT and IPSL in collaboration with the French Embassy. DefKo Ak Niep (Do it with others) is another FabLab in Dakar set up by the NGO @Kerthiossane³⁵⁵. This NGO is focused on raising public awareness of new forms of expression and developing better understanding of culture and digital artistic practices in other areas including education and training.

³⁵⁵ <http://www.ker-thiossane.org/>

14. REPUBLIC OF SOUTH AFRICA

14.1 Introduction

The Republic of South Africa occupies the southernmost part of the African continent, stretching latitudinally from 22° to 35° south and longitudinally from 17° to 33° east, flanked on the west by the Atlantic Ocean and on the east by the Indian Ocean, whose waters meet at the country's most southern tip, Cape Agulhas. South Africa has common boundaries with Namibia, Botswana and Zimbabwe, while Mozambique and Swaziland lie to the north-east. The Kingdom of Lesotho is completely enclosed by South African territory in the south-east.

South Africa has a surface area of 1,219,909 sq km, made up of nine provinces, each with its own legislature, premier and executive councils. The provinces (Western Cape, the Eastern Cape, KwaZulu-Natal, the Northern Cape, Free State, North West, Gauteng, Mpumalanga and Limpopo) have their own distinctive landscapes, vegetation and climate.

According to the 2018 Statistics South Africa Mid-year Report, South Africa has an estimated population of 57.75 million. About 29.5% of the population is aged younger than 15 years and c.8.5% (4.89 million) are 60 or over. The literacy rate is estimated at 94.3% (2016). Total fixed-line telephone subscriptions are estimated to be 3,629,141 (2017) with mobile-cellular teledensity of 168 telephones per 100 persons (2017, CIA World Factbook). Combined fixed-line and mobile-cellular teledensity exceeds 145 telephones per 100 persons; consists of carrier-equipped open-wire lines, coaxial cables, microwave radio relay links, fiber-optic cable, radiotelephone communication stations, and wireless local loops; key centers are Bloemfontein, Cape Town, Durban, Johannesburg, Port Elizabeth, and Pretoria (2016).

The City of Tshwane (Pretoria) is the capital of South Africa with a population of 3.27 million. The other largest metropolitan municipalities by population include: Johannesburg (4.94 million), Cape Town (4 million), Ekurhuleni (3.38 million), Durban (2.9 million) and Port Elizabeth (1.26 million) (2016 est. The Local Government Handbook – South Africa)

South Africa is a middle-income emerging market with abundant natural resources, well-developed financial, legal, communications, energy, commercial agriculture and transport sectors, a stock exchange ranked among the top 20 in the world, and a modern infrastructure supporting efficient distribution of goods throughout the southern African region.



According to the 2017 rankings of the World Bank, South Africa has the world's 32nd largest economy by GDP (Gross Domestic Product) and is the second largest economy in Africa, valued at USD 349.419 million. South Africa spends close to 10% of GDP on ICT goods and services of which most are imported.

Gross Expenditure on Research and Development (GERD) as a percentage of gross domestic product (GDP) or R&D intensity was 0.77% in 2014/15. The business sector was the largest performer of R&D in 2014/15, with expenditure amounting to 45.3% of GERD. The higher education sector accounted for the second-largest expenditure on R&D at 28.5% of GERD. Expenditure on R&D by science councils accounted for 17.1% of GERD, followed by government at 6.5%, while the R&D expenditure recorded for not-for-profit organisations increased by 2.7%. ICT Research and Development spend is 0.077% of GDP with overall Research and Development spend around 0.77% of GDP (The National Survey of Research and Experimental Development (R&D Survey of 2014/15 released in 2017).

In relation to Communications, according to 2017 figures (CIA World FactBook), there were 3.6 million fixed phone lines in use compared with 91.8 million mobile phones and 29.3 million Internet users. In terms of ICT infrastructure, there is an African Coast to Europe (ACE) under sea cable landed at Cape Town, EASSy (Eastern African Submarine System) and SEACOM landed at Mtunzini, South Africa Far East landed at Melkbosstrand and Mtunzini, SAT-E / WASC landed at Mtunzini and West African Cable System landed at Yzerfontein.

South Africa has a vibrant Higher Education sector and according to the Higher Education Management Information System (HEMIS) of the Department of Higher Education and Training, there were over 1 million students enrolled in 2017 in the 26 state-funded tertiary institutions (Universities, Universities of Technology). As at 31 December 2017 there were 100 private institutions of Higher Education registered (HEMIS of the Department of Higher Education and Training). Amongst the 26 state-funded universities, three were established in the past 4 years, i.e. 2014-2016. There are currently 50 registered public Technical Vocational Education and Training (TVET) Colleges, covering training from Grade 10 to 12 and career-orientated education and vocational training³⁵⁶. Furthermore, there are 291 registered private TVET Colleges (Department of Higher Education and Training).

14.2 ICT Background

The South African ICT sector is the largest on the African continent. As an increasingly important contributor to South Africa's GDP, the country's ICT and electronics sector is both sophisticated and developing. The country has a network that is 99% digital and includes the latest in fixed-line, wireless and satellite communications, making it the most developed telecommunications network on the continent. South Africa's IT industry is characterised by technology leadership, particularly in

³⁵⁶ <http://www.dhet.gov.za/EducationInstitutions/FetColleges/tabid/174/Default.aspx/FetColleges/tabid/174/Default.aspx>

the field of electronic banking services. South African companies are world leaders in pre-payment, revenue management and fraud prevention systems, and in the manufacture of set-top boxes, all exported successfully to the rest of the world. Several international corporates, recognised as leaders in the IT sector, operate subsidiaries from South Africa, including but not limited to IBM, Google, Unisys, Microsoft, Cisco, Intel, Systems Application Products (SAP), Dell, Novell, Dimension Data and Compaq. The ICT industry includes hardware, software, networking, telecommunications and related professional products and services. South Africa's ICT and electronics sectors are expected to continue showing strong growth in the future. ICT activities are coordinated across a number of government departments and agencies, research institutions, universities and the private sector.

Infrastructure investment is a key priority of the National Development Plan. There are 18 national strategic integrated projects (SIPs)³⁵⁷ whose implementation oversight is lead by the Presidential Infrastructure Coordinating Commission. The Infrastructure plan is monitored and centrally driven and has the objectives of skilling, industrialisation and R&D. SIPs 15 and 16 are focused on ICT and related fields. SIP 15 "Expanding access to communication technologies" looks at providing 100% broadband coverage to all households by 2020 by establishing core points of Presence (POP's) in district municipalities and extending new fibre networks. The schools' connectivity rollout is focusing on approximately 27000 public schools. The terrestrial broadcasting signal TV migration from analogue to digital is also included as part of SIP 15. South Africa missed the June 2015 deadline to migrate from analogue to digital. The Government has begun with the rollout of subsidised set-top-boxes to qualifying households.

SIP 16: "SKA & MeerKAT" looks at the implementation of the MeerKAT and SKA, which is a global mega science project, building an advanced radio-telescope facility linked to research infrastructure and high speed ICT capacity. The SKA is expected to be commissioned in 2026. The MeerKAT is South Africa's small version and a precursor to the SKA. As at March 2017 SANReN, which has capacity of 10Gbps, has connected over 227 sites that include University campuses, Science councils, academic hospitals and government agencies such as the South African Weather Services.

The Department of Telecommunications and Postal Services (DTPS) is responsible for the national ICT Policy. The ICT policy review process led to the approval by Cabinet in 2016 of the National Integrated ICT Policy White Paper. The purpose of the review was to examine the policy and regulatory frameworks that affect postal services, ICT, networks, infrastructure and frequency spectrum allocation and licensing, and investments in the sector. The Broadband Policy "South Africa Connect" was adopted in 2013. The National Cyber Security Policy Framework (NCPF) is in place and its implementation plan is being developed. In this respect, the Department of Science

³⁵⁷ <http://www.info.gov.za/issues/national-development-plan/>

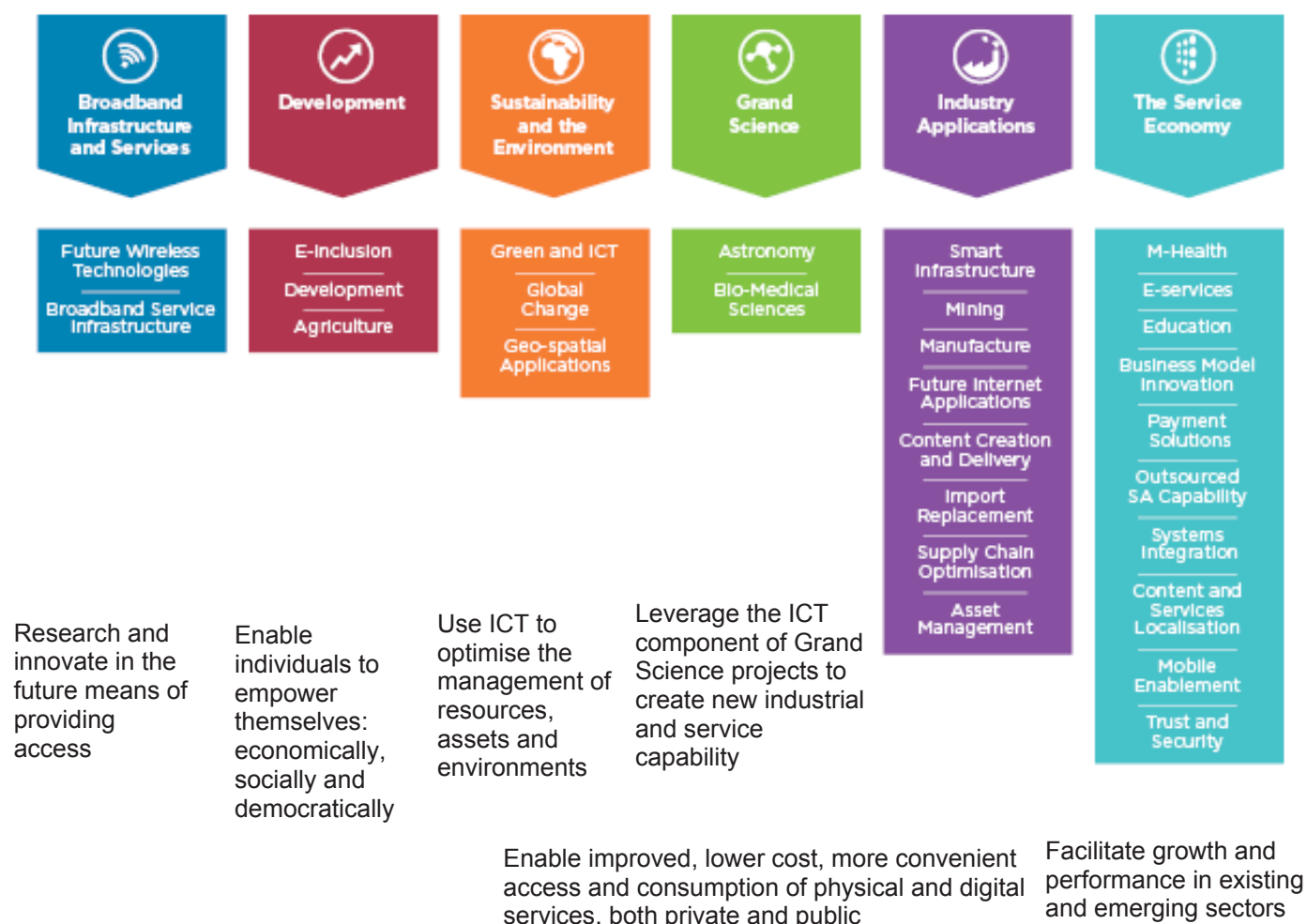
and Technology is developing the Cybersecurity RDI Programme as part of the implementation plan of the NCPF.

The Department of Science and Technology is responsible for the ICT Research, Development and Innovation Policy. The coordination of activities under the national ICT research and development programme is informed by the ICT RDI Strategy, which was approved in 2007. The purpose of the National ICT R&D and Innovation strategy is to create an enabling system for the advancement of ICT R&D and innovation, within the context of the broader national R&D strategy.

In 2013, Cabinet approved the ICT Research and Development Implementation Roadmap. The ICT RDI Implementation Roadmap is the means by which the ICT national research, development, and innovation (RDI) Strategy is put into a coherent set of actionable plans. The roadmap provides the required strategic direction to guide South Africa in planning, coordinating and managing its investment in ICT programmes of research, technology development and innovation activity over the 10 years, i.e. 2013-2022.

In developing the ICT RDI Roadmap, a process was followed which included a baseline desktop research study, consultation with experts in the relevant fields and series of workshops with relevant stakeholders within the South African ICT RDI ecosystem. In total, 63 technology themes and trends were analysed. Utilising this total list, 27 market opportunities of interest to South African ICT RDI ecosystem were identified, evaluated and clustered. From this process, six main clusters were evident. The following are the six clusters and the market opportunities under each cluster:

- **Broadband Infrastructure and Services** (Future Wireless Technologies, Broadband Services Infrastructure)
- **Development** (e-inclusion; Development and ICT for Agriculture)
- **Sustainability and Environment** (Green and ICT; Global Change; Geo-spatial applications)
- **Grand Science** (Astronomy; Biomedical sciences)
- **Industry Applications** (Smart infrastructure; Mining, Manufacture; Future internet applications; Content creation and delivery; Import replacement; Supply chain optimisation; Asset management)
- **The Service Economy** (m-health; e-Services; e-Education; Business model innovation; Payment solutions; Outsourced SA capability; Systems integration; Content and services localisation; Mobile enablement; Trust and security).



ICT RDI Roadmap Market Opportunity Areas

The development of capabilities and directing funding to these areas revolves around working on partnerships between government and the private sector, academia and science councils. The ultimate goal of ICT R&D Implementation Roadmap is to accelerate the growth of ICT RDI in South Africa.

The Department of Science and Technology has since established a programme management unit (PMU) called the Office of Digital Advantage (ODA), which is tasked with coordinating the implementation of the ICT RDI Roadmap. As such, the mission of the ODA is to provide guidance and support for the implementation of the roadmap in order to strengthen the ICT RDI ecosystem in South Africa, facilitate an increase in ICT RDI investments, and provide a platform for informed decision-making with respect to strategic areas of focus and the allocation of funding.

14.3 Current ICT Initiatives and projects

Some of the ICT Initiatives that are currently ongoing at national level include the development of Strategies emanating from the Integrated ICT Policy Review Process, the implementation of the South African National Research Network & Tertiary Education and Research Network, the Digital

Terrestrial Television Migration process, SA Connect Broadband infrastructure rollout, and the Square Kilometer Array/MeerKAT.

14.3.1 Integrated ICT Policy White Paper

Cabinet approved the Integrated ICT Policy White Paper in 2016. Stemming from the White Paper are 3 Strategies that the Department of Telecommunications and Postal Services (DTPS) gazetted since the beginning of 2017, and these are: the National e-Strategy, the National eGovernment Strategy and Roadmap, and the ICT SMME Support Strategy.

In order to improve the R&D environment, this policy white paper adopts the following:

- An ICT RDI Investment and Planning Advisory Council including senior officials from various government departments, as well as industry and research institutions (Universities and Science Councils) and civil society representatives, will be established to support the Office of Digital Advantage, which is provided for in the ICT RDI Roadmap.
- The ICT RDI Investment and Planning Advisory Council will be Co-Chaired by the Departments of Telecommunications and Postal Services (DTPS); and Science and Technology (DST)
- The Council must establish a working relationship with other institutions that are involved in RDI.
- The establishment of a Digital Development Fund, which will also provide for the funding of research and development in the space of ICT.

The Council must continuously evaluate priority areas, promote and monitor policies to support RDI growth in the ICT sector

14.3.2 The South African National Research Network

The South African National Research Network (SANReN) is funded by the Department of Science and Technology (DST) and implemented by the CSIR Meraka Institute since 2009. SANReN now provides a minimum of 1Gbps and to 10Gbps redundant connectivity to all South African public universities, many science councils and entities such as the South African Weather Services – a total of 227 sites as at March 2017. The average bandwidth available per SANReN site is 3.537 Gbps. SANReN also supports the Square Kilometer Array/MeerKAT and the South Africa Antarctic Research Programme. Over 1 million students, academics and researchers in public institutions presently benefit from the network. The SANReN network forms part of a comprehensive South African government approach to a National Integrated Cyberinfrastructure System (NICIS) to ensure successful participation of South African researchers in the global knowledge production effort. Together with the Centre for High Performance Computing (CHPC) and the Data Intensive Research Initiative for South Africa (DIRISA), the SANReN network forms the key components of this cyberinfrastructure (CI) as a core scientific research infrastructure for South Africa.

TENET (Tertiary Education and Research Network of South Africa) operates SANReN, which comprises of a national backbone, several metropolitan rings, and some dedicated long-haul circuits to connect specific research installations. TENET is a member of UbuntuNet Alliance and has global

interconnectivity through UbuntuNet Alliance's London and Amsterdam gateways to GEANT (European Research and Education Network). It is a beneficiary of both Africa Connect and Africa Connect 2 infrastructures project through UbuntuNet Alliance.

Funding Sources: Department of Science Technology

Geographic coverage: National

14.3.3 The Digital Terrestrial Television Migration

The Digital Terrestrial Television (DTT) roll-out is one of the key priorities of the South African government. Its aim is to migrate the terrestrial analogue television broadcasting infrastructure to the digital broadcasting. The migration is necessary due to the developments in the telecommunications technologies and the international obligations for broadcasting digital migration. In 2006, the International Telecommunications Union (ITU) passed a resolution that all countries of Europe, Africa, Middle East and the Islamic Republic of Iran (region 1) should migrate from analogue to digital broadcasting services by June 2015. South Africa missed the agreed deadline. While the Department of Communications aimed to complete the process of migrating from analogue to digital broadcasting at the end of 2018, it will miss this deadline. A new deadline has not yet been set by the Minister of Communications. In August 2008, Government approved the Broadcasting Digital Migration (BDM) Policy. The BDM Policy provides for a framework within which digital migration should take place in the country. The current period of migration is called dual illumination, when both analogue and digital TV signals are available to viewers. The Broadcasting Digital Migration Policy provides that set-top-boxes will be sourced from local manufacturers to increase the sector's contribution to the real economy, improving growth and facilitating job creation. The Cabinet approved a subsidy scheme called Scheme for Ownership Subsidy (SOS) which will provide TV owning households 70% towards the cost of the STB as an incentive aimed at reaching the poorest TV owning households. The subsidy will be funded through the Universal Service and Access Fund (USAF). The rollout of set-top-boxes by the South African Post Office started in 2015. However, on 11 October 2018 Government announced that cabinet approved a "revised delivery model" for implementation of the project. "The model adopts a market/retail-driven approach through collaboration and partnerships with the private sector and industry. This will mean government will no longer be involved in the procurement, warehousing, transportation and installation of set-top boxes. The precise details of the new model are still being worked out.

Funding sources: Universal Service and Access Fund (USAF)

Geographic coverage: National

14.3.4 SA Connect Broadband rollout

SA Connect is government's ambitious national broadband policy that was adopted in 2013, and aims to deliver widespread broadband access to 90% of the country's population by 2020, and 100% by 2030. The 1st phase of the project is to connect all schools, health facilities, government

offices, Thusong Centres and post offices, in eight rural district municipalities, to broadband services.

Funding: Department of Telecommunications and Postal Services

Geography: National

14.3.5 The Square Kilometer Array

The Square Kilometre Array (SKA) is an array of radio telescopes. The majority of the SKA (the full dish array and the dense aperture array) is being built in Africa. The core - i.e. the region with the highest concentration of receivers - will be constructed in the Northern Cape, South Africa, about 80 km from the town of Carnarvon (the same site as where the MeerKAT is being constructed). The sparse aperture array (low frequency array) is being built in Australia. South Africa has already demonstrated its excellent science and engineering skills by designing and building the [MeerKAT](#) radio telescope – as a precursor to the SKA. The technology developed for MeerKAT is cutting-edge and the project is creating a large group of young scientists and engineers with world-class expertise in the technologies which will be crucial in the next 10 – 20 years, such as very fast computing, very fast data transport, large data storage, large networks of sensors, software radios and imaging algorithms. The MeerKAT is funded by the Department of Science and Technology while the SKA is funded by a consortium of countries. Full operation of the SKA is planned for 2026.

The first seven dishes of the local precursor instrument - known as KAT-7 - were completed by December 2010 and were commissioned in 2015/16. It is the world's first radio telescope with dishes made of fibre glass. KAT-7 is an engineering prototype for the 64-dish MeerKAT. The SKA project has now entered its final pre-construction phase (or detailed design phase) before construction of SKA1 commences in 2018. The SKA1 will incorporate the 64-dish MeerKAT, which was completed in March 2018 and was officially inaugurated on 03 July 2018.

Funding: SKA is funded by a consortium of countries, while the MeerKAT is funded the Department of Science and Technology

Geographical coverage: Carnarvon, Northern Cape. Some of the SKA Antennae will be located in a few African countries

14.4 National ICT Research Capacity and Priorities for Cooperation

14.4.1 National Priorities

South Africa's ICT Research Priorities are informed by the ICT RDI Roadmap (2013) which identified the following 27 priority areas grouped into six clusters of market opportunities:

- **Broadband Infrastructure and Services** (Future Wireless Technologies, Broadband Services Infrastructure)
- **Development** (e-inclusion; Development and ICT for Agriculture)

- **Sustainability and Environment** (Green and ICT; Global Change; Geo-spatial applications)
- **Grand Science** (Astronomy; Biomedical sciences)
- **Industry Applications** (Smart infrastructure; Mining, Manufacture; Future internet applications; Content creation and delivery; Import replacement; Supply chain optimisation; Asset management)
- **The Service Economy** (m-health; e-Services; e-Education; Business model innovation; Payment solutions; Outsourced SA capability; Systems integration; Content and services localisation; Mobile enablement; Trust and security).

The ICT R&D Roadmap, implemented over a period of ten years (2013 - 2022), has directed investment focused on system-level outputs. South Africa's ambitions in terms of outputs in the ten years are the following:

- Human Capital Development: Masters (675), PhDs (450) and Post Docs (225);
- Knowledge Generation: Publications (1,700), Patent Applications (120) and Registered Patents (42); and
- Technology Development: Prototypes (470), Technology Packages (124) and Products and Services to Market (40)

To achieve the system level outputs outlined above, each stage of developing a market opportunity, i.e. explore, build critical mass, embed capacity and commercialise requires different mix of funding instruments. The following are funding instruments available in the South African ICT R&D and innovations ecosystem: Scholarships and studentships, technology development, RDI-enabling infrastructure, Partnership (PPP) and Collaboration, Research Chairs (National Research Fund), Centers of Competence (Technology Innovations Agency), seed funding and venture capital.

14.4.2 National Research Capacity

The table below provides an overview of some of the universities with ICT/Engineering Courses:

Institution	Location	* Total University Student Population (2015 Year)	ICT/Engineering Department(s)
Council for Scientific and Industrial Research (CSIR)	Gauteng	Students based at the CSIR are registered with various Universities for their study Degrees. There are 3 business units of the CSIR that have strong ICT competencies, i.e. Meraka Institute; the Defence, Peace, Safety and Security (DPSS) and the Modelling and Digital Sciences (MDS)	Earth Observation Science and ICT; Human Language Technologies; Knowledge Technologies; Networks and Media; Integrative Systems, Platforms, Technologies; Cyber-infrastructure; Education and Rural Development
Cape Peninsula University of Technology	Western Cape	32674 **13 MSc+PhD	Informatics and Design
Central University of Technology	Free State	14193 **2 MSc+PhD graduates	Computer Science and Informatics
Durban University of Technology	KwaZulu-Natal	27023	Electronics Engineering, Information Technology

Technology	Natal	**33 MSc+PhD graduates	Technology
Fort Hare University	Eastern Cape	13458 **45 MSc+PhD graduates	Computer Science, Information Systems
Nelson Mandela University	Eastern Cape	26 630 (year 2014) 3,718 PostGraduates	Electrical Engineering, School of Information and Communication Technology, Computer Science, Institute for ICT Advancement
North West University	North West	64070 **126 MSc+PhD graduates	School of Mathematics and Physical Sciences; School of Electrical, Electronic, Information Systems and Computer Science; School of Information Technology
Mangosuthu University of Technology	KwaZulu-Natal	11518 **0 MSc+PhD graduates	Department of Electrical Engineering, Department of Information Technology
Rhodes University	Eastern Cape	8007 **44 MSc+PhD graduates	Computer Science; Information Systems; Physics and Electronics
Sefako Makgatho Health Sciences University	Gauteng	5074 **67 MSc+PhD graduates	
Stellenbosch University	Western Cape	29613 **337 MSc+PhD graduates	Computer Science; Electrical and Electronics Engineering; Centre for Languages and Speech Technology
Sol Plaatje University	Northern Cape	5074 **0 MSc+PhD graduates (The University became operational only in 2014)	
Tshwane University of Technology	Gauteng	57246 **58 MSc+PhD graduates	Departments of Electrical Engineering, Computer Engineering, Computer Networks, Systems Development, Enterprise Application Development and ICT Management
Walter Sisulu University	Eastern Cape	25993 **19 MSc+PhD graduates	Department of Mathematical Sciences & Computing
UNISA (Online and Distance Learning Institution)	Gauteng	337944 **56 MSc+PhD graduates	Department of Electrical Engineering; Centre for Software Engineering; School of Computing
University of Cape Town	Western Cape	27809 **347 MSc+PhD graduates	Computer Science; Information Systems; Electrical Engineering; Centre for Information Technology & National Development in Africa
University of Free State	Free State	30418 **195 MSc+PhD graduates	Computer Science and Informatics
University of Johannesburg	Gauteng	49452 **103 MSc+PhD graduates	Academy of Computer Science and Software Engineering; Department of Electrical and Electronics Engineering Science
University of KwaZulu Natal	KwaZulu-Natal	45506 **310 MSc+PhD graduates	School of Mathematics, Statistics and Computer Science, School of Computer Engineering
University of Limpopo	Limpopo	18907 **28 MSc+PhD graduates	Department of Computer Science
University of Pretoria	Gauteng	55984 **523 MSc+PhD	Departments of Computer Science, Informatics and Information Science.

			Departments of Systems Engineering, Electronic and Computer Engineering.
University of Venda	Limpopo	18907 **14 MSc+PhD graduates	Department of Computer Science and Information Systems
University of Zululand	KwaZulu-Natal	16891 **7 MSc+PhD graduates	Department of Computer Science.
University of the Western Cape	Western Cape	20382 **107 graduates MSc+PhD	Department of Earth Sciences, Department of Computer Science, Department of Physics and Astronomy,
University of Witwatersrand	Gauteng	33777 **415 graduates MSc+PhD	Department of Computer Science. Department of Electrical & Information Engineering.
Vaal University of Technology	Gauteng	17678 **2 MSc+PhD graduates	Electrical Engineering, Information and Communication Technology, and Software studies

*Source: Higher Education Management Information System (HEMIS) of the Department of Higher Education and Training in South Africa

** Total number of MSc and PhD graduates in 2015 from the Major Study Fields of Natural Science, Engineering and technology and Health sciences.

South Africa has 26 publicly funded institutions of Higher Education. In addition, the country has research centres that have the human and infrastructural capacity to successfully participate in joint collaborative projects under Horizon 2020. Three (3) of these 26 universities were only established between 2014-2017.

➤ **CSIR/ Modeling and Digital Science, Meraka Institute and DPSS³⁵⁸**

- Research areas include: Earth observation science and information technology; Human language technologies and knowledge technologies; Information security; Robotics; Integrative systems, platforms and technologies; Cyber infrastructure; Cloud Computing; High Performance Computing; Internet of Things; Software Engineering and Architectures; Robotics, Mathematical Modelling, Data Analytics, ICT in Education, Wireless Communications, Artificial Intelligence, Cybersecurity, Cyber warfare, Advanced Sensor Networks and Future Wireless Technologies.

➤ **Cape Peninsula University of Technology**

- Departments include: Electrical, Electronic and Computer Engineering; Industrial & Systems Engineering; Information and Communications Technology Academy; Informatics and Design
- Research areas include: Energy Harvesting; RFID; and Simulation & Modelling.

➤ **University of Cape Town³⁵⁹**

³⁵⁸ <http://www.meraka.org.za>

³⁵⁹ <http://www.uct.ac.za>

- Departments include: Department of Electrical Engineering; Computer Science and Information Systems and Centre for Information Technology & National Development in Africa
- Research areas include but not limited to: Radar Remote Sensing; Computation and Applied Mechanics; Broadband Networks & Applications; Digital Image Processing; Telecommunications Networks; Information for Community Oriented Municipal Services; Control systems and Mechatronics; Bio-inspired Robotics & Biomechanics; Software Defined Radio; Computer networks, network applications, future internet technologies; Power and Energy Systems Protection, Distributed Generation and Microgrids; and Space Technology.
- **University of Pretoria**³⁶⁰
 - Departments include: Department of Computer Science, Informatics and Information Science; Departments of Systems Engineering, Electronic and Computer Engineering
 - Research areas include: Computational Intelligence; Computer and Information Security; Geographic Information Science; ICT for Sustainable Development; Computer Science Education Didactics and Applications; System Specifications and Formal Methods; Software Engineering and Software Architecture; Advanced Sensor Networks; Biomedical engineering; Control Systems; Energy Systems; Intelligent Systems; Telecommunications and Signal Processing; Mobile Development Platforms
- **University of Johannesburg**³⁶¹
 - Departments include: Department of Electrical and Electronics Engineering Science; Academy of Computer Science and Software Engineering
 - Research areas include: Industrial Electronics Technology; Telecommunications and Stream Processing Research
- **University of KwaZulu Natal**³⁶²
 - Departments include: School of Mathematics, Statistics and Computer Science; School of Computer Engineering; Department of Electrical Engineering
 - Research areas include: Radio Access and Rural Technologies; Image Processing and Pattern Recognition; Simulation and Modelling; Sensor Web, Biomedical Informatics, Bioinformatics
- **UNISA**³⁶³
 - Departments include: Department of Electrical Engineering; Centre for Software Engineering; School of Computing

³⁶⁰ <http://www.up.ac.za>

³⁶¹ <http://www.uj.ac.za/>

³⁶² <http://www.ukzn.ac.za/>

³⁶³ <http://www.unisa.ac.za>

- Research areas include: Image Control and Processing; Intelligent Systems; Parallel and Distributed Computer Architectures; Intelligent Agents; Electrical Systems and Wireless Communications
- **University of Witwatersrand**³⁶⁴
 - Departments include: Department of Electrical and Electronics Engineering Science; Academy of Computer Science and Software Engineering
 - Research areas include: Biomedical Engineering; Computational Electromagnetics; Electrical Machines and Drives; Software and Information Engineering; Systems and Control; Telecommunications; Artificial Intelligence and Machine Learning.
- **Nelson Mandela University**³⁶⁵
 - Departments include: Electrical Engineering; School of Information and Communication Technology, Computer Science; Institute for ICT Advancement
 - Research areas include: eHealth, Cyber Security, Human Language Technologies; Mobile Development Platforms;
- **Rhodes University**³⁶⁶
 - Departments include: Computer Science; Information Systems; Physics and Electronics
 - Research areas include: Cloud Computing; Mobile Development Platforms; Living Labs
- **Stellenbosch University**³⁶⁷
 - Departments include: Electrical and Electronics Engineering; Computer Science; Centre for Languages and Speech Technology
 - Research areas include: Embedded Systems; Mobile Computing; Sensors; Human Language Technologies; Mobile Development Platforms; Parallel Programming; Robotics; Search Applications; Software Engineering and Architectures; Visualisation; Simulation and Modelling; Internet of Things
- **University of the Western Cape**³⁶⁸
 - Research areas include: Human Language Technologies; Software Design; High Performance Computing
- **Central University of Technology**³⁶⁹
 - Departments include: Department of Electrical, Electronic & Computer Engineering; Department of Information Technology
 - Research areas include: Voice over IP; Mobile Platforms

³⁶⁴ <http://www.cs.wits.ac.za>

³⁶⁵ <http://www.nmmu.ac.za/>

³⁶⁶ <http://www.cs.ru.ac.za>

³⁶⁷ http://www.eng.sun.ac.za/portal/page/portal/Engineering/Engineering_Home

³⁶⁸ <http://www.uwc.ac.za/>

³⁶⁹ <http://www.cut.ac.za/>

- **Durban University of Technology**³⁷⁰
 - Departments include: Department of Electronic Engineering; Department of Accounting and Informatics
 - Research areas include: Human Computer Interaction; Software as a Service
- **Tshwane University of Technology**³⁷¹
 - Departments include: Departments of Electrical Engineering, Computer Engineering; Computer Networks, Systems Development, Enterprise Application Development; ICT Management
 - Research areas include: Human Computer Interaction; Service Design
- **University of Fort Hare**
 - Departments include: Department of Computer Science & Information Systems
 - Research areas include: Living Labs
- **North West University**³⁷²
 - Departments include: School of Electrical, Electronic, Information Systems and Computer Science; School of Information Technology; School of Mathematics and Physical Sciences
- **University of Free State**³⁷³
 - Departments include: Department of Computer Science and Informatics
 - Research areas include Software Design
- **University of Limpopo**³⁷⁴
 - Departments include: Department of Computer Science
 - Research areas include: Software Design
- **University of Venda**³⁷⁵
 - Departments include: Department of Computer Science and Information Systems
 - Research areas include: Ontologies and Semantic Web; Parallel Programming; Software Design and Development; Biomedical Sensors
- **University of Zululand**³⁷⁶
 - Departments include: Department of Computer Science; Department of Physics and Engineering
 - Research areas include: Image Processing; Enterprise Data Integration; Model Driven Development; Wireless Communication Technologies

³⁷⁰ <http://www.dut.ac.za>

³⁷¹ <http://www.tut.ac.za>

³⁷² <http://www.nwu.ac.za>

³⁷³ <http://www.ufs.ac.za>

³⁷⁴ <http://www.ul.ac.za/>

³⁷⁵ <http://www.univen.ac.za>

³⁷⁶ <http://www.uzulu.ac.za/>

➤ **Vaal University of Technology³⁷⁷**

- Departments include: Department of Electrical Engineering; Department of Information and Communications Technology; Department of Software Studies
- Research areas include: Human Language Technologies; Information Security; Augmented Reality

➤ **Walter Sisulu University**

- Departments include: School of Mathematics and Computation; Schools of Computing; Schools of Technology
- Research areas include: Bioinformatics; Big Data Curation; OERS; Knowledge Capturing

There are also some private sector companies that conduct R&D in ICT, albeit on a limited scale while producing world class innovation products and services. There are also some ICT multinational companies that have or are intending to setup R&D facilities/centres in South Africa.

14.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders the following thematic areas are considered important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners include
eHealth	Health management solutions and business models for mobile and online services; Health Information Systems/Electronic Health Records in rural clinics with limited connectivity; Health diagnosis and Surveillance; Mechanisms and alarms to deal with compliance issues; Telemedicine and remote diagnosis using mobile platforms; Improved logistics of drugs to dispensing point to patient	Medical Research Council; Sefako Makgatho Health Sciences University; Nelson Mandela University; University of the Free State; CSIR Meraka Institute; University of Stellenbosch; University of Cape Town; Walter Sisulu University; Tshwane University of Technology; University of Pretoria; University of Johannesburg; Rhodes University
Technology-enhanced Learning	Integration of ICT into education to improve learning experience; Cloud Solutions for personalised and classroom eLearning given low connectivity; Content Development	University of Stellenbosch; CSIR Meraka Institute; Centre for Innovation in Learning and Teaching (CILT), University of Cape Town; University of South Africa; Department of Basic Education; Cape Digital Foundation
eAgriculture	Use of ICT to support enhanced agricultural production; Cloud Model for Agricultural sector; Integration of early	University of Stellenbosch; Agricultural Research Council; University of Pretoria;

³⁷⁷ <http://www.vut.ac.za>

	warning systems into mobile platforms	University of KwaZulu-Natal; Cape Peninsula University of Technology; Institute of Wine Biotechnology (Stellenbosch University); CSIR Meraka Institute; University of Johannesburg; Mobile Laboratory Southern Africa.
eGovernment	Public Service Delivery; Optimisation of municipality systems; Smart Cities	University of Stellenbosch; Meraka Institute; Walter Sisulu University; University of Cape Town; Department of Telecommunications and Postal Services; State Information Technology Agency; South African Local Government Association.
Environment	Sensor technology to monitor water loss and quality; air quality; Smart electricity grids	University of Pretoria; University of Johannesburg; University of Cape Town; University of the Witwatersrand; CSIR Meraka Institute; Tshwane University of Technology
Digital Inclusion	Application of ICT for socio-economic development in national context; optimal use of ICT for socio-economic development of marginalised and rural communities	University of Cape Town; University of Zululand; Fort Hare University; Rhodes University; CSIR Meraka Institute; Department of Science and Technology; University of Limpopo
Energy	Electrical energy systems; Thermal systems; Energy systems analysis; Strategic energy technologies; Nuclear and Hydrogen Energy; Energy efficiency; Nanobiotechnology; Fuel cell and nanotechnology; Biofuels;	University of South Africa; University of Stellenbosch; University of Witwatersrand; North-West University; Fort Hare University; Rhodes University; Cape Peninsula University of Technology; Nelson Mandela University; University of Cape Town

14.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	<p>Witwatersrand University: School of Electrical and Information Engineering (Centre for Systems and Control): Research activities range from classical control to modern linear and non-linear control. All aspects of systems and signals namely, modelling, synthesis, control analysis and design pertaining to linear and non-linear, time-invariant as well as time varying systems and signals form part of the focus.</p> <p>Cape Peninsula University of Technology, Center for Real-Time Distributed Systems: Research includes networked control systems, standard based substation automation, and optimization of complex systems.</p> <p>University of Johannesburg, Academy of Computer Science and Software Engineering: Component-based embedding of Agent-enhancing characteristics in Agents and Multi-Agent systems.</p> <p>Durban University of Technology, Institute of Systems Science: research into real-world questions using multi-disciplinary computational and mathematical systems methods, as well as simulation and mathematical methods.</p>
Advanced Computing	University of Cape Town, University of Western Cape, CSIR Meraka: High Performance Computing
Future Internet	<p>CSIR Meraka Institute: Internet Protocol (IP) networking; Infrastructure cloud; Application platforms; Protocol platforms; Free and open source (FOSS) operating systems; Internet of Things and IP multimedia subsystem.</p> <p>University of Pretoria, SACH: Advanced sensor networks with focus on hardware, test-beds and implementation aspects.</p> <p>University of Johannesburg, Academy of Computer Science and Software Engineering: Services oriented architecture, Software as service, Cloud computing and Cybersecurity.</p>
Content Technologies & Information Management	<p>University of Johannesburg, Department of Computer Science and Software Engineering: Services Computing and Trust Management with focus on trust and reputation models, Services Oriented Architecture, Software as Service, and Cloud Computing.</p> <p>Witwatersrand University: School of Electrical and Information Engineering: Focus on Big Data (Medical Informatics) and Bioinformatics.</p> <p>University of Pretoria, Department of Information Science: Knowledge Management, Information Processes,</p>

	<p>Meta-context of Information.</p> <p>CSIR, Meraka Institute: Use of semantic technologies to employ novel forms of representing information and reasoning about it and coupling of the structures employed in semantic technologies to existing information sources such as database systems, semi-structured and unstructured sources of information.</p>
Robotics	<p>CSIR Modelling and Digital Sciences: Mobile intelligent, autonomous systems for areas of field robotics that promote intelligent behaviour such as in mining and other unstructured environments.</p> <p>University of Stellenbosch, Department of Electrical and Electronics: Dynamics and control of autonomous systems, e.g. low earth orbiting satellites, manned and unmanned fixed and rotary wing aircraft, underwater vehicles, computer systems, as well as Biomedical Electronics.</p> <p>Tshwane University of Technology, Department of Electrical Engineering: Control, Image Processing and Machine Intelligence.</p> <p>University of Pretoria, Department of Electrical, Electronic and Computer Engineering, SACH: Research is on computational intelligence, with a particular focus in computational swarm intelligence, learning from zero knowledge using competitive coevolution, and evolutionary algorithms.</p> <p>University of Cape Town, Department of Electrical Engineering: Control and Instrumentation, Image Processing and Vision Systems.</p> <p>Cape Peninsula University of Technology, Electrical, Electronic and Computer Engineering: Satellite systems engineering.</p> <p>Nelson Mandela University: Department of Mechatronics: focus on adaptive robotic control based on infrared indoor GPS (IR-GPS), adaptable mechanical fixturing approach for the mitigation of manufacturing errors; and wireless, intelligent control of a mobile office robot.</p>

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>University of the Free State, School of Medicine: High throughput biology, Bioinformatics/Computational Biology, Novel drug discovery and Advanced cloning systems.</p> <p>CSIR Biosciences: Multi-disciplinary research in synthetic biology and the aptamer technology to provide cutting-edge tools to analyse, prevent and diagnose intractable public health problems such as HIV/AIDS, TB and malaria.</p> <p>Medical Research Council: Medical Imaging Research</p>

	<p>Unit: Medical imaging that specifically addresses the functional brain imaging, measurement of cancer cell topography; and characterising neuromuscular function.</p> <p>Medical Research Council, The Drug Discovery and Development Research Unit: Specialises in the use of innovative drug discovery tools for the development of drugs targeted for treatment of infectious and other endemic African diseases.</p> <p>Medical Research Council, Exercise Science and Sports Medicine Research Unit: Neurophysiology and the control mechanisms of fatigue; Genetic determination of athletic ability and susceptibility to exercise-induced injuries; Physical exercise in the prevention and rehabilitation of chronic disease states.</p> <p>Medical Research Council, Environment & Health Research Unit: Urbanization and urban health; Lead poisoning prevention; Exposure to environmental pollution; the public health implications of heat stress (climate change).</p> <p>University of Pretoria, School of Health Systems and Public Health: research on sustainable malaria control methods from the biochemical and the biological to the chemical and the physical.</p> <p>University of Johannesburg, Department of Biochemistry: Human Genetics and Infectious Diseases; Diabetes Therapeutic Research and Chromatin Research.</p> <p>University of Stellenbosch, Faculty of Health and Medicine: Research on Infectious Diseases, especially TB and HIV/AIDS; Reproductive Health; Mental Health, especially psychiatric disorders; Non-Communicable Diseases, especially diabetes, cancer and cardiovascular disease; Public Health, especially health systems and evidence-based health care; Genetics and Injury, Trauma and Rehabilitation.</p> <p>Rhodes University, Natural Products and Medicinal Chemistry Research Group: Research focus on function and medicinal chemistry of biologically active natural products, medicinal plants and quality of herbal medicines, as well as the design and synthesis of new medicinal agents.</p> <p>University of Cape Town, Drug Discovery and Development Center: Structural Biology - structure-based drug discovery; Computational Chemistry: Virtual Screening and Modelling. Medicinal Chemistry (Hit to Lead and Lead Optimization). In vitro and in vivo Mycobacteriology and Parasitology. Biochemistry: Recombinant protein expression, protein isolation and characterisation, and development of enzyme assays for evaluating inhibitor efficacy</p> <p>Nelson Mandela University (NMU): Health informatics,</p>
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	<p>ICT for disease management, Information security and interoperability standards</p> <p>Walter Sisulu University (WSU): Health informatics - Electronic Medical Records for Community Health Clinics</p> <p>Tshwane University of Technology (TUT): Medical Devices development, eHealth and mHealth platforms.</p>
Energy	<p>University of South Africa, The College of Science, Engineering and Technology: Research on Fuel cell and nanotechnology focuses on using energy in a wiser fashion in order to minimise environmental hazards, as well as ways of optimising the efficiency with which it is produced.</p> <p>University of Stellenbosch, Department of Electrical and Electronics: Research on electrical energy systems focusing on broadly on generation, transmission, conversion and control of electrical energy, including renewable energy. A parallel hybrid electrical vehicle was recently developed and tested.</p> <p>University of Witwatersrand; Department of Mechanical, Industrial and Aeronautical Engineering: Thermal systems with focus on Combustion Analysis Software Development Solar Powered Low DT Liquid-Piston Stirling Engines for Water Pumping, Optimising the Performance of an Alcohol Fuelled Engine, Regenerative Internal Combustion Engines, Mine Cooling System Research and Flow Characteristics of Ice/Water/Air Mixture.</p> <p>North-West University, Schools of Mechanical and Nuclear Engineering: Research includes bioethanol and biodiesel production; Clean coal technology including coal minerology and refinement; Nuclear and hydrogen energy. The university also has Research Chairs in Nuclear Energy, Clean Coal technology, Biofuels and Hydrogen Energy.</p> <p>Fort Hare University, Institute of Technology: Research on Energy efficiency and the built environment, gasification of biomass, improvement of the collection efficiency of the cyclone, thermal and chemical analysis of the gasification process.</p> <p>Rhodes University, Biotechnology Innovation Center: The research is currently focused on three core research areas, i.e. Biosensors, Biofuel Cells, Nanobiotechnology. The research is aimed at realizing innovative and commercialisable solutions in the development of sensors and in accessing alternative energy from waste products.</p> <p>Cape Peninsula University of Technology, Centre for Substation Automation and Energy Management Systems provides specialised training, research and development in new technologies to improve power systems in South Africa.</p> <p>Nelson Mandela University: Research and development on Strategic energy technologies for South Africa</p>

	<p>University of Cape Town, Energy Research Center: Energy efficiency, environmental and climate change, energy systems analysis and planning.</p>
Food Security and Sustainable Agriculture	<p>Agricultural Research Council: Research and development on the natural agricultural resources, viz, soil, climate and water, as well as on appropriate agricultural engineering technologies for both small- and large-scale agricultural producers. Develop technologies to improve the quality of animals and develop genetic and physiological methods to identify and study superior livestock breeding. Applied research on improvement and cultivation of grain crops and commercial crops, e.g. tobacco.</p> <p>University of KwaZulu-Natal, Department of Agricultural Engineering: Engineering and science research in three main areas: Energy and supply chains in biomass production and processing, Systems irrigation soil & water engineering, as well as Food processing and post harvest engineering.</p> <p>Cape Peninsula University of Technology, Functional Foods Research Unit: Research on metabolic and nutritional effects of functional foods or premixes with functional food characteristics in human volunteers participating in well-designed clinical trials.</p> <p>University of Stellenbosch, Institutes of Plant Biotechnology: Research on carbohydrate partitioning in higher plants, engineering of biopolymer synthesis, plant growth and resistance of plants to abiotic stress.</p> <p>Institute of Wine Biotechnology: Molecular and Metabolite Profiling of vines, Advanced chemical-analytical techniques in viticulture, oenology and biotechnology; Computational Biology and Biomathematics.</p> <p>CSIR Biosciences: Key areas of focus are Natural product chemistry; Food science and technology; Natural product processing, and Indigenous knowledge and biodiversity management.</p> <p>University of Johannesburg, Department of Biotechnology: Nutritional and sensory quality of African indigenous crops; Antioxidant potential of phytochemicals in plant foods; sensory acceptable mageu-based gluten free bread. Plant biotechnology and post harvest physiology and technology of fresh fruit, vegetables and cut flowers.</p> <p>University of Pretoria: Veterinary aspects of food safety and food security, Molecular studies on infectious and parasitic diseases of animals, Phytomedicine and ethno-veterinary medicine, as well as Anatomical and physiological studies on animals.</p>
Inclusive, Innovative and Reflective Societies	<p>Fort Hare University and Rhodes University, Telkom Center of Excellence in ICT4D: The research focus of the centre is on the use of computing technology for socio-economic development of marginalized and rural</p>

	communities. CSIR Meraka: Human Languages Technologies, Speech-to-text technologies, wireless communication technologies for rural implementation.
Secure Societies	CSIR MDS, CSIR DPSS, University of KwaZulu-Natal, University of Limpopo, Tshwane University of Technology, University of Stellenbosch

Level of Research Maturity

South Africa has a vibrant, well-developed research community and a good track record in collaborative research (193 FP7 projects with over **€37.3 million** in research funding).

Up to September 2018, South African organisations are involved in **122** Horizon 2020 projects with funding of over **€28.3** million across a range of thematic areas:

- TRANSPORT, H2020-MG-2014_TwoStages - **AEROGUST** (RIA) - University of Cape Town
- INFRA, H2020-INFRA SUPP-2014-2 **B3Africa** (CSA) - Stellenbosch University & University of the Western Cape
- ENV, H2020-SC5-2014-one-stage - **BioMOne** (RIA) - MINTEK
- ENV, H2020-SC5-2014-two-stage **ECOPOTENTIAL** (RIA) - Council for Scientific and Industrial Research
- LEIT-SPACE, H2020-COMPET-2014 - **EUSPACE-AWE** (CSA) - National Research Foundation
- INFRA, H2020-INFRA IA-2014-2015 - **EVAg** (RIA) - Agricultural Research Council (ARC); National Health Laboratory Services)
- ENV, H2020-WASTE-2014-one-stage - **EWIT** (CSA) - Council for Scientific and Industrial Research, E-Waste Association of South Africa, Mintek & Pikitup Johannesburg (Proprietary Limited, Choma Municipal Council)
- ENV, H2020-SC5-2014-one-stage - **green.eu** (CSA) - Stellenbosch University; **INTRAW** (CSA) - Council for Scientific and Industrial Research
- ENV, H2020-SC5-2014-two-stage - **GREEN-WIN** (RIA) - University of Cape Town
- INFRA, H2020-INFRA SUPP-2014-2 - **MAGIC** (CSA) - Council for Scientific and Industrial Research; **Sci-GaIA** (CSA) - Council for Scientific and Industrial Research
- FOOD, H2020-SFS-2014-1 - **PROIntensAfrica** (CSA) - Agricultural Research Council (ARC)
- FOOD, H2020-SFS-2014-2 - **nEUROSTRESSPEP** (RIA) - University of Cape Town
- Science with and for Society, H2020-ISSI-2014-1 - **NUCLEUS** (CSA) - National Research Foundation
- SOCIETY, H2020-INT-INCO-2014 - **RINEA** (CSA) - Department of Science and Technology

- SECURITY, H2020-DRS-2014 - **SEREN 3** (CSA) - Council for Scientific and Industrial Research
- HEALTH, H2020-PHC-2014-single-stage - **TBVAC2020** (RIA) - Kwazulu Natal Research Institute for TB-HIV (K-RITH) NPC, Stellenbosch University & University of Cape Town
- Science with and for Society, H2020-GARRI-2014-1 - **TRUST** (CSA) - The South African San Institute Trust, University of Cape Town & University of the Witwatersrand Johannesburg
- HEALTH, H2020-PHC-2014-two-stage - **VIROGENESIS** (RIA) - University of Kwazulu-Natal
- ENV, H2020-WATER-2014-one-stage - **WaterWorks2014** (ERA-NET- Cofund) - Water Research Commission
- FOOD, H2020-BG-2014-2 - **AtlantOS** (RIA) - Council for Scientific and Industrial Research
- HEALTH, H2020-HCO-2014 - **SMART2D** (RIA) - University of The Western Cape
- LEIT - ICT-39-2015- **mHealth4Afrika** (RIA) - Nelson Mandela University
- H2020-WATER-2015-one-stage - **AfriAlliance** (CSA) - Icfei - Local Governments for Sustainability - Africa; Water Research Commission; Council for Scientific and Industrial Research
- H2020-INFRADEV-1-2015-1 - **IN-SKA** (RIA) - National Research Foundation
- H2020-SC5-2015-one-stage - **INTMET** (RIA) - Mintek
- H2020-INT-SOCIETY-2015 - **GLOBUS** (RIA) - University of the Witwatersrand Johannesburg
- H2020-NMP-ERA-NET-2015 - **M-ERA.NET 2** (ERA-NET-Cofund) - Department of Science and Technology
- H2020-SC5-2015-one-stage- **STRADE** (CSA) - University of the Witwatersrand Johannesburg; Dmt-Kai Batla Pty Ltd
- ERA-NET-Cofund - **WaterWorks2015** (ERA-NET-Cofund) - Water Research Commission
- H2020-LCE-2015-1-two-stage - **MinWaterCSP** (RIA) - Notus Fan Engineering; Stellenbosch University; Kelvion Thermal Solutions (Pty) Ltd
- H2020-WATER-2015-one-stage - **FERTINNOWA** (CSA) - Optima Agrik Pty Ltd
- H2020-Adhoc-2014-20 - **ICRI 2016** (CSA) - Department of Science and Technology
- H2020-DS-2015-1 - **FutureTrust** (IA) - Law Trusted Third Party Services Pty Ltd
- H2020-WATER-2015-two-stage - **WATERSPOUTT** (RIA) - Stellenbosch University; **SafeWaterAfrica** (RIA) - Tshwane University of Technology; Council for Scientific and Industrial Research; Advance Call Pty Ltd; Virtual Consulting Engineers Vce; Stellenbosch University
- H2020-NMP-2015-two-stage - **caLIBRAte** (RIA) - National Health Laboratory Services

- H2020-INT-INCO-2015 - **ESASTAP 2020** (CSA) - Academy of Science of South Africa; National Research Foundation; Technology Innovation Agency; Department of Science and Technology
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA)- Department of Science and Technology
- H2020-BG-2016-1 - **MarTERA** (ERA-NET-Cofund) - Department of Science and Technology
- H2020-SC5-2016-OneStageB - **COP21 RIPPLES** (RIA) - University of Cape Town
- H2020-EO-2016 - **CyanAlert** (IA) - Cyanolakes (Pty) Ltd
- H2020-SC5-2016-OneStageB - **ERA-MIN 2** (ERA-NET-Cofund) - Department of Science and Technology
- H2020-INFRA SUPP-2016-1 - **AENEAS** (RIA) - Council for Scientific and Industrial Research; University of Cape Town; National Research Foundation
- H2020-INFRA DEV-2016-1 - **JUMPING JIVE** (CSA) - Department of Science and Technology; **RINGO** (CSA) - University of the Witwatersrand Johannesburg
- H2020-SC1-2016-RTD - **SPICES** (RIA) - University of Limpopo; **anTBiotic** (RIA) - Task Foundation Npc; University of Cape Town)
- H2020-INFRA IA-2016-1 - **RadioNet** (RIA) - Department of Science and Technology
- H2020-FOF-2016 - **4D hybrid** (RIA) - Council for Scientific and Industrial Research
- H2020-SFS-2016-1 - **LEAP-AGRI** (ERA-NET-Cofund) - National Research Foundation; Department of Science and Technology
- H2020-INFRA SUPP-2016-1 - **SEACRIFOG** (CSA) - University of the Witwatersrand Johannesburg; National Research Foundation
- H2020-SC5-2016-OneStageB - **ITERAMS** (RIA) - University of Cape Town
- H2020-SwafS-2016-1 - **SIENNA** (CSA) - University of Cape Town
- H2020-SFS-2016-2 - **TROPICSAFE** (RIA) - Patho Solutions (Pty) Ltd; Vinpro; Stellenbosch University; University of Pretoria)
- H2020-MSCA-RISE-2014 - **CREATE-Network** (MSCA-RISE) - Council for Scientific And Industrial Research
- H2020-MSCA-RISE-2014 - **EVE** (MSCA-RISE) - Armaments Corporation of South Africa; Esteq Engineering (Pty) Ltd; University of Pretoria
- H2020-MSCA-RISE-2014 - **GreenBubbles** (MSCA-RISE) - Noordwes-Universiteit; Divers Alert Network Southern Africa
- H2020-MSCA-RISE-2014 - **MAT4TREAT** (MSCA-RISE) - Stellenbosch University
- H2020-MSCA-ITN-2014 - **SAF21** (MSCA-ITN-ETN) - South African Association for Marine Biological Research
- H2020-MSCA-RISE-2014 - **Sustain-Owner** (MSCA-RISE) - University of Pretoria

- H2020-MSCA-RISE-2014 - **PARTY** (MSCA-RISE)Cape Peninsula University of Technology; The South African Institute Trust
- H2020-MSCA-RISE-2014 - **FlyHigh** (MSCA-RISE) - Agri Protein Technologies (Pty) Ltd
- H2020-MSCA-IF-2014 - **WORMTUMORS** (MSCA-IF-GF) - University of Cape Town
- H2020-MSCA-RISE-2015 - **Ocean Medicines** (MSCA-RISE) - University of the Western Cape
- H2020-MSCA-RISE-2015 - **FAB-MOVE** (MSCA-RISE) - University of the Western Cape
- H2020-MSCA-RISE-2015 - **MediHealth** (MSCA-RISE) - Tshwane University of Technology
- H2020-MSCA-RISE-2015 - **MIREL** (MSCA-RISE) - University of Cape Town
- H2020-MSCA-RISE-2015 - **PEARL** (MSCA-RISE) - University of Johannesburg
- H2020-MSCA-RISE-2015 - **RUBICON** (MSCA-RISE)University of Cape Town
- H2020-MSCA-RISE-2015 - **SOLIRING** (MSCA-RISE) - University of Cape Town
- H2020-MSCA-IF-2014 - **NEARCONTROL** (MSCA-IF-GF) - University of Kwazulu-Natal
- H2020-MSCA-RISE-2014 - **Muscle stress relief** (MSCA-RISE) - Stellenbosch University
- H2020-MSCA-RISE-2015 - **SYMICS** (MSCA-RISE) - University of the Witwatersrand Johannesburg
- H2020-MSCA-RISE-2015 - **GEMCLIME** (MSCA-RISE) - University of Cape Town
- H2020-BBI-PPP-2015-2-1 - **TECH4EFFECT** (BBI-RIA) - Stellenbosch University
- H2020-MSCA-ITN-2016 - **BioCapture** (MSCA-ITN-ETN) - ReSyn Biosciences
- H2020-EO-2016 - **CyanoAlert** (IA) - Cyanolakes (Pty) Ltd
- H2020-MSCA-RISE-2016 - **INTERWASTE** (MSCA-RISE) - Tshwane University of Technology; University of Kwazulu-Natal
- H2020-MSCA-RISE-2016 - **VirFree** (MSCA-RISE) - University of Pretoria
- H2020-MSCA-COFUND-2015 - **WIRL** (MSCA-COFUND-FP) - African Arts Institute
- H2020-MSCA-RISE-2016 - **CID** (MSCA-RISE) - University of South Africa
- H2020-MSCA-COFUND-2016 - **SPARK** (MSCA-COFUND-DP) - South African Institute for Aquatic Biodiversity
- H2020-MSCA-RISE-2016 - **TICASS** (MSCA-RISE) - University of the Witwatersrand Johannesburg
- ERC-2016-COG - **Honeyguides-Humans** (ERC-COG) - University of Cape Town
- H2020-SFS-2016-2 - **InnovAfrica** (RIA) - Agricultural Research Council (ARC)
- H2020-SFS-2017-1 - **AfriCultuReS** (RIA) - South Africa National Space Agency
- H2020-SFS-2017-1 - **CIRCASA** (CSA) - Agricultural Research Council (ARC)
- H2020-SC5-2017-OneStageB - **INFAC** (RIA) - GALSA (PTY) LTD
- H2020-MSCA-RISE-2017 - **INFINITE-CELL** (MSCA-RISE) - University of the Western Cape

- H2020-COMPET-2017 - **TechTIDE** (RIA) - South Africa National Space Agency
- H2020-MSCA-RISE-2017 - **HYDRIDE4MOBILITY** (MSCA-RISE) - TR Design; University of the Western Cape; Impala Platinum
- H2020-MSCA-RISE-2017 - **ThermaSMART** (MSCA-RISE) - University of Pretoria
- H2020-MSCA-ITN-2017 - **ANTHUSIA** (MSCA-ITN-EJD) - Abahlali baseMjondolo Movement; Centre for Development and Enterprise; Southern Africa Labour and Development Unity; Wits School of Governance
- H2020-MSCA-RISE-2017 - **BIODEST** (MSCA-RISE) - Stellenbosch University
- H2020-MSCA-RISE-2017 - **CARE4C** (MSCA-RISE) - Merensky Timber (Pty) Ltd; Stellenbosch University
- H2020-SC1-2017-Single-Stage-RTD - **RISE** (RIA) - University of Cape Town
- H2020-SC5-2017-OneStageB - **WaterWorks2017** (ERA-NET-Cofund) - Water Research Commission
- H2020-SC5-2017-OneStageB - **TWIGA** (RIA) - South African Weather Service
- H2020-MSCA-RISE-2017 - **DiCoMI** (MSCA-RISE) - Vaal University of Technology
- H2020-MSCA-RISE-2017 - **CatChain** (MSCA-RISE) - Tshwane University of Technology
- H2020-SFS-2017-2 - **CO-CREATE** (RIA) - University of Cape Town
- H2020-SwafS-2017-1 - **RRING** (RIA) - National Research Foundation
- H2020-SEC-2016-2017-2 - **SEREN 4** (CSA) - Council for Scientific and Industrial Research
- H2020-ICT-2017-1 - **WAZIHUB** (IA) - Makers Be Like
- H2020-SFS-2017-2 - **DEFEND** (RIA) - Agricultural Research Council (Arc); University of Pretoria
- H2020-SC5-2017-OneStageB - **PACIFIC** (RIA) - Institute of Mine Seismology (PTY)LTD
- ERC-2016-ADG - **Group-Dynamics-TCB** (ERC-ADG) - Kalahari Research Trust
- H2020-SFS-2017-2 - **HOMED** (RIA) - University of Pretoria
- H2020-BG-2018-1 - **AANChOR** (CSA) - National Research Foundation, Council for Scientific and Industrial Research, Department of Science And Technology
- H2020-JTI-IMI2-2016-10-two-stage - **AIMS-2-TRIALS** (IMI2-RIA) - Stellenbosch University
- H2020-WATER-2015-two-stage - **DAFNE** (RIA) - University Of Zambia
- H2020-ICT-2015 **DMC-MALVEC** (RIA) - Ministry Of Health
- H2020-SC5-2015-two-stage - **Ground Truth 2.0** (IA) - World Wide Fund for Nature (WWF) Zambia
- H2020-SFS-2018-1 - **LEAP4FNSSA** (CSA) - National Research Foundation, Agricultural Research Council (Arc), Department of Science and Technology

- H2020-SFS-2018-1 - **MicrobiomeSupport** (CSA) - University of Pretoria
- H2020-LC-SC3-2018-Joint-Actions-1 - **PRE-LEAP-RE** (CSA) - National Research Foundation, Department of Science and Technology
- H2020-NMBP-SPIRE-2018 - **PreMa** (IA) - Stellenbosch University, Mintek, Transalloys Pty Ltd
- H2020-MSCA-RISE-2018 - **RESIST** (MSCA-RISE) - University of Cape Town
- H2020-MSCA-ITN-2018 - **ReTraCE** (MSCA-ITN-ETN) - African Circular Economy Network
- H2020-SC1-2016-RTD - **SURG-Africa** (RIA) - The Surgical Society of Zambia
- H2020-MSCA-IF-2017 - **SUSTINNO** (MSCA-IF-GF) - University of Cape Town

14.5 Innovation Spaces

South Africa has experienced a growth in Innovation Spaces that support technology entrepreneurs across the country. Innovation Spaces include: The Innovation Hub³⁷⁸, mLab Southern Africa³⁷⁹, which is hosted within the Innovation Hub since 2011; the Cape Innovation and Technology Initiative (CITI), BinarySpace³⁸⁰; Codebridge³⁸¹; Eastern Cape Information Technology Initiative (ECITI)³⁸² Incubation programme; Invo Tech Incubator,³⁸³ FabLab³⁸⁴ (now 8 locations); Impact Amplifier³⁸⁵; JoziHub / Jozi Hackerspace³⁸⁶; Softstart BTI³⁸⁷; StartUp 90³⁸⁸; SmartXchange³⁸⁹; Workshop 17³⁹⁰ in Cape Town;; LaunchLab³⁹¹; Impact Hub Johannesburg³⁹²; The House 4 Hack³⁹³. These Innovation Spaces support Incubation (The Innovation Hub; ECITI; InvoTech; Softstart BTI; LaunchLab; SmartXchange), Co-working Spaces (JoziHub; Start-Up Garage; LaunchLab; Impact Hub Johannesburg; Workshop 17) and Acceleration Services (mLab SA; StartUp 90, Impact Amplifier).

Some of these Innovation Spaces are profiled below:

Funded by the Gauteng Provincial Government and established in 2001, *The Innovation Hub* is located close to the CSIR and Department of Science and Technology (DST). Africa's first internationally accredited Science and Technology Park, and a member of the International

³⁷⁸ www.theinnovationhub.com/

³⁷⁹ www.mlab.co.za

³⁸⁰ <http://www.binaryspace.co.za/>

³⁸¹ www.codebridge.co.za

³⁸² www.eciti.co.za/

³⁸³ www.invotech.dut.ac.za/

³⁸⁴ <http://www.fablab.co.za/>

³⁸⁵ <http://www.impactamplifier.co.za/>

³⁸⁶ <http://jozihub.org/>

³⁸⁷ www.softstartbti.co.za/

³⁸⁸ www.startup90.com/

³⁸⁹ <http://www.smartxchange.co.za/>

³⁹⁰ <http://workshop17.co.za/>

³⁹¹ <http://www.launchlab.co.za/>

³⁹² <http://johannesburg.impacthub.net/>

³⁹³ <http://www.house4hack.co.za/>

Association of Science Parks (IASP), The Innovation Hub hosts mLab Southern Africa, Maxum Business Incubator (co-working and dedicated space), the Climate Innovation Centre (providing access to finance and facilities and technical, business and policy advisory services) and BioPark (promoting health, agriculture and environment industries) which are all focused on enterprise development. Skills development programmes include CoachLab (nine month skills and leadership development programme preparing postgraduate students for industry), and FabLab, the eKasi Labs and Kusile Mobile Science Labs (focused on youth empowerment). OpenIX (like Demola) focuses on Open Innovation bringing together stakeholder challenges with solution providers, while Gap Biosciences, Gap Green, Gap Medical and Gap ICT are competitions for seed funding and incubation services.

mLab Southern Africa is a mobile solutions laboratory and startup accelerator focused on the development of innovative mobile applications and services. The mLab Southern Africa has physical presence in The Innovation Hub in Pretoria (Gauteng), Cape Town (Western Cape), Kimberley (Northern Cape) and Polokwane (Limpopo). It is a member of AfriLabs. It also has virtual programs in Southern Africa. It supports the development of mobile solutions in the consumer, design, enterprise, public and gaming sectors. The mLab Southern Africa also runs coding skills academies, hackathons and is the coordinator of the DEMOLA Network activities in South Africa.

The Technology Innovation Agency is the focal point in the Southern African Innovation Support Programme (SAIS 2), which is supported by the Ministry of Foreign Affairs Finland from 2017 - 2021. The SAIS2 Innovation Fund provides grants for locally implemented projects with partners from the beneficiary countries (Botswana, Namibia, South Africa, Tanzania and Zambia). TIA and mLabs is a member of the SAIS2 Connected Hubs.

CITI is an initiative that includes a multi-faceted co-working space and ideal location for supporting and incubating tech and tech-based businesses in Cape Town. It provides co-working space and professional services as well as an online and workshop based pre-incubation programmes and on-site incubation and accelerator programmes for entrepreneurs at different stages of development. It is part of the Silicon Cape Initiative.

BinarySpace is a Hackerspace in the Vaal Triangle. It provides a space where people with common interests in technology, science and electronic art, can meet, socialize and/or collaborate. BinarySpace also provides introductory short courses in electronics for technology enthusiasts.

CodeBridge is a startup incubator, which bring together activists, technologists, journalists, data analysts, designers, programmers and others, to create opportunities for innovations and alternative ways to address some of society's challenges. Their incubation services include training and tailored bootcamps, mentorship, business strategy, funding assistance and working space.

Established in East London by the Eastern Cape Provincial Government in 2004, *ECITI* provides incubation services (Launch pad, Seed, eGrowth) to ICT and film oriented entrepreneurs. Its

incubation programme is focused on providing infrastructure and business support services, early stage development of ICT and film entrepreneurs with a particular focus on women, youth and disabled.

InvoTech offers a ten-week entrepreneurship programme based at Durban University of Technology, focused on the Green Technology, Digital Creative Industry, Software or Mobile Application Sectors. Launched in August 2011, the incubator is co-funded by the Small Enterprise Development Agency (Seda). InvoTech provides access to a Seed Fund in partnership with the Technology Innovation Agency, focused on Energy, Transportation, Advanced Materials, Environment & Waste related innovation.

The **FabLabs**, supported by the Department of Science and Technology, are a small-scale version of a production factory. While the FabLab cannot be used to manufacture thousands of assembly-line products, it can be used by individuals to create prototypes from arts and crafts to engineering and architecture models. Computer based design or drawing software, in most cases Open Source software, is used to create designs that are then automatically manufactured by an appropriate cutting, milling or forming machine. The cross-cutting nature of the fabrication technologies lends itself to basic science, engineering and technology (SET) education, needed to stimulate the “can make” attitude amongst the youth, especially those still affected by the digital divide. Access to the FabLab gives any community a head start in basic engineering and design technologies, and an opportunity to experiment and learn from others while being creative and innovative. The fabLabs has a footprint in eight locations in South Africa.

Impact Amplifier supports high growth impact businesses to access funding from both local and international investors. It hosts a range of accelerator and training programmes to get high growth potential impact businesses ready for investment. Impact Amplifier has a core set of services to assist impact investors to build quality business portfolios, which can thrive commercially whilst making a meaningful contribution to social and environmental challenges.

Launched in February 2013, **JozHub** is a Johannesburg based technology incubator supported by the Praekelt Foundation, Venture Solutions, IS Labs, AfriLabs, Silicon Cape Initiative, Google Entrepreneur programme, Indigo Trust and the Omidyar Network, offering co-working space, mentoring, community events and conference facilitates. It focuses on supporting early stage innovation to assist in business growth and job creation in the technology and social impact spheres. There are currently 35 resident start-ups at the hub.

Based in Midrand, Gauteng and launched in 2005, **Softstart Business and Technology Incubator (Softstart BTI)** is focused on ICT and electronics related startups, providing services including: co-working space; mentoring and training; human resource and payroll; communications and marketing; strategy, policy and research and development; legal support and fund raising. Softstart BTI has full support and sponsorship from the SEDA Technology Programme (STP) a programme under the Small Enterprise Development Agency of the Department of Small Business

Development. STP sponsors the Business Incubation initiative from its inception to fast track the links between the government, private sector and academia of South Africa.

Startup 90 in Capetown offers a three-month accelerator programme (primarily focused on the education, finance, healthcare and agriculture sectors) with mentoring and co-working space. It primarily focuses on start-up and early stage businesses.

The Durban Technology Hub t/a **SmartXchange** is an incubator whose core mandate is to provide enterprise development services to small, medium and micro enterprises (SMME'S) in the Media, Information Communication Technology and electronics sector. SmartXchange manages a programme that identifies and assists in developing quality skilled MICTe SMME's in KwaZulu Natal and also to build a pool of skilled MICTe workers that will enable KwaZulu Natal businesses to flourish. SmartXchange partners with corporates from the MICTe industry, tertiary institutions and the government sector to work towards up skilling entrepreneurs and the youth.

Workshop 17 is a hub that aims to accelerate innovation and entrepreneurship for a positive social and economic change. It is now the work place of more than 240 entrepreneurs, innovators and professionals and 80 companies. Corporates, government and civil society use the space daily for meetings, teachings and events. The public drops in for informal work and meetings in the café. Workshop 17 is supported by OPEN and V&A Waterfront.

Launched in October 2012, **Capetown Garage** offers co-working and meeting space. The Cape Town Garage is one of 3 co-working tech hubs in Africa – There are also 2 Garages in Nairobi, Kenya. The Garages are meant to create the environment for young businesses to build networks, share ideas and collaborate on new projects.

Founded in 2011, 88mph Accelerator has now closed. It invested in 36 companies in Kenya and South Africa between 2011 - 2014 and during 2015 - 2016 reoriented itself to focus on the commercial success of investee companies. By then it had a footprint in Cape Town, Nairobi (Kenya) and Lagos (Nigeria).

Hosted by the University of Stellenbosch and launched in August 2013, **LaunchLab** is a business incubator that uses an Ideas Programme with workshops and Pitching Den before selecting the top ideas for seed funding, mentoring and coaching and incubation space. This innovative programme is open to university students (not limited to Stellenbosch) and external entrepreneurs. It is primarily focused on assisting technology and innovation businesses in ICT (specifically Payments & Big Data and Paid Media), Cleantech, Agriculture and Education. It is also supported by the Nedbank.

Part of ImpactHub Network, *Impact Hub Johannesburg* offers co-working space in Braamfontein, and offers a fee based three-month Social Impact Accelerator Programme. Its community is comprised of entrepreneurs, freelancers, techies, consultants, investors, creatives, artists and more. The ImpactHub Network footprint stretches from Amsterdam to Accra, Singapore to San Francisco,

Impact Hub is a rapidly expanding, diverse global network of over 13,000+ members in 85+ locations.

*The **House 4 Hack*** is an initiative to bring together technology specialists and entrepreneurs in an informal setting. The setting is a 400 m² house in Lyttleton Manor in Centurion (Pretoria) and is equipped with various prototyping tools. Furthermore, the plan is to provide access to business mentorship, startup finance and training on a variety of topics. The idea is to combine concepts from hackerspaces and innovation incubators in a way that hobbyists, people in corporations or want to take a break from their regular jobs can experiment with start-ups in a safe friendly environment.

A UK-based not-for-profit, Nesta partnered with the African Leadership Academy to establish the Global Innovation Policy Accelerator in Johannesburg, South Africa.

ygap³⁹⁴ is an Australian based not-for-profit focused on supporting impact entrepreneurs to implement local solutions to local problems. ygap South Africa supports startups by providing a one week live-in accelerator focused on strengthening business models and provide necessary tools to achieve viability. Supported start-ups can access grant of investment funding of AUD\$10 - \$50k. ygap also have a dedicated program for female led early stage startups – **yher Africa**.

14.6 Venture capital/ Angel investor

In addition to Innovation Spaces, South Africa has a number of venture capital/ angel investor companies. The association of these companies is the SAVCA (Southern African Venture Capital and Private Equity Association)³⁹⁵ which represents over 160 members. It promotes the venture capital and private equity industry and profession in Southern Africa.

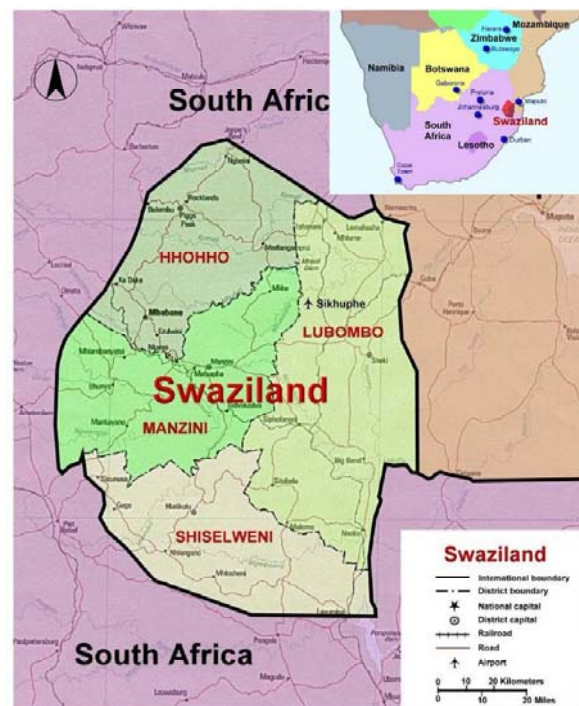
³⁹⁴ <https://ygap.org>

³⁹⁵ <https://savca.co.za/>

15. ESWATINI (FORMER SWAZILAND)

15.1 Introduction

The Kingdom of Eswatini (formerly known as Swaziland) is a landlocked country in Southern Africa, bordered by South Africa to the North, South and West and Mozambique to the East. Eswatini consists of four administrative regions (Hhohho, Manzini, Lubombou, and Shiselweni) as shown in the map. It has a surface area of 17,363 square kms. The population is estimated at 1.087 million inhabitants (est July 2018 CIA World FactBook) with a literacy rate of 87.5%. 61.8 percent of the total population is between 15 and 64 years of age. Mbabane, the capital city, has a population of 68,000 (2018, CIA World Factbook). The official languages are English and Siswati. Eswatini is classified as a low middle-income developing country with a GDP per capita of US\$9,800 (2016 est).



In relation to Communications, Eswatini has three telecommunications service providers (Eswatini Posts and Telecommunication Corporation, Eswatini Mobile and Eswatini MTN) with over 80% mobile penetration. The country's backbone infrastructure is NGN and is connected to the SEACOM undersea cable through Maputo, Mozambique. For redundancy, more connections to Telkom and Broadband Infranco in South Africa have been established. For Telkom links, cables exit through Ngwenya and Lavumisa and for Infranco, cables exit through Mahamba terminating at Terraco. Fibre optic is laid throughout the country. There are thirteen Internet providers including the Government Computer Services Department and 414,724 Internet users representing 28.6% penetration (July 2016 est). According to 2016 figures (CIA World FactBook), there were 44,612 fixed phone lines compared with 967,262 mobile phones. The National Internet Exchange Point (IXP) was put in place in April 2014. Free Internet access is planned to be provided to schools and hospitals through an ITU and Wanderport Eswatini projects.

There is one public university (the University of Eswatini) and four private institutions of Higher Education: The Southern Nazarene University, Limkokwing University, the Christian Medical University, which opened in August 2013 and Amadi.

15.2 ICT Background

The major policies in the ICT sector include:

➤ **The Eswatini Post and Telecommunications Corporation Act of 1983 (revised 2013)**

This Act of Parliament regulated the Communication Industry until 2013 under the Ministry of information Communication and Technology. A new Law (Eswatini Communications Commission Act 2013) replaced this Act in July 2013 and liberalised the telecommunication industry by establishing an Independent regulator.

➤ **ICT Policy 2004 (subsumed by NICI Policy 2006)**

Within Government, IT services are provided by the Government Computer Services (GCS) Department which is responsible for providing efficient and cost-effective Information Technology (IT) services to all Government Ministries and Departments, and to respond to parastatal and public enterprise organizations. It will do this by:

- Assisting clients to manage Information by leveraging on ICTs;
- Setting up and maintaining a reliable network infrastructure;
- Providing a secure environment for data;
- Keeping abreast of ICT Development regionally/internationally by attending seminars, subscribing to ICT Publications
- Developing its IT Human resource to sustain on going as well as planned development

The NICI Policy 2006 subsumed the ICT Policy 2004.

➤ **National Information and Communication Infrastructure (NICI) Policy 2006**

This Policy, which is under the Ministry of Information, Communication and Technology was approved by Cabinet in August 2006. Subsequent to this an implementation plan has been developed with assistance from the Economic Commission for Africa (ECA) a UN agency through its Subregional Office (ECA-SA), and the Government of Finland, through the Cooperation in the Development of Information and Communications Technologies in Africa Programme. The National Information and Communication Infrastructure Implementation Plan for 2012-2016 (NICI Plan 2016) is based on the principles espoused in the National Development Strategy (NDS) and will guide Eswatini in the exploitation of (ICT) as a catalyst in the national development efforts.

➤ **STI Policy 2012**

The STI Policy is a more recent development but the efforts to develop the policy started more than a decade ago. This policy is within the Ministry of Information, Communications and Technology and was developed with assistance from UNESCO and approved by Cabinet in April 2012. The vision of this policy is: *Harnessing, utilising and advancing STI in order to become an innovative and competent nation, thus achieving the goals of Vision 2022 (NDS).*

The Department of Research, Science, Technology and Innovation (RSTI) under the Ministry of Information, Communication and technology has embarked on an important exercise of developing, reviewing and amending all STI Policy regimes aimed at creating an enabling environment for

research and development. The department has also been given a mandate to operationalize the newly established Royal Science Technology Park, which was established in terms of the Royal Sciences Technology Park Act, 23 of 2012. The Department of RSTI is currently reviewing the National Research, Science and Innovation Policy of 2012. The department is also reviewing the National Research Council Bill, which was drafted in funding from United Nation Development Programme (UNDP). The Bill is envisaged to resuscitate the defunct National Research Council, which was initially established in 1974.

As part of the policy review process, in December 2016, the department of RSTI collaborated with the Central Statistics Office in the Ministry of Economic Planning, Royal Eswatini Technology Park (RSTP), Eswatini Economic and Policy Analysis (SEPARC) and the University of Eswatini (UNISWA) in hosting an in-country training workshop on Research, Experimental Development & Innovation data collection and analysis, for the production of related internationally comparable core indicators. NEPAD Planning and Coordinating Agency (NPCA) and UNESCO Institute for Statistics (UIS Dakar) facilitated this workshop. The Ministry of ICT commissioned the Royal Science and Technology Parks and Eswatini Economic Policy Analysis and Research Centre to conduct a National Research & Development and Innovation Survey in March 2017. The survey results were then utilized to draft policy briefs, which will be used for the policy review exercise and publication in the third edition of the African Innovation Outlook (AIO).

The reviewed National Science, Technology and Innovation Policy is in line with the country's National Development Strategy (NDS) and Vision 2022. The reviewed policy is also in line with the international and Regional Frameworks and Strategies.

The country is also in the process of developing its Bioeconomy strategy to enable operationalization of the Biotechnology Park.

In an endeavour to strengthen the national system of innovation the country is also engaged in the following activities:

- A constitution for the academy of science has been drafted with the assistance of the Academy of Science of South Africa.
- In the process of signing memorandum of understanding with the Republic of South Africa, Kenya and Mozambique on Research, Science and Technology. This MOUs will enable the country to fund research in a cost effective manner. The MOU between the Republic of Mozambique and the Kingdom will be signed in January 2019, with the MOUs between the Kingdom and the Republic of South Africa and Kenya due to be signed by March 2019.
- The country has also engaged TWAS to assist with the development of the national WISET chapter in line with Regional Frameworks and Strategies
- The country is in the process of developing the Indegenous Knowledge System Policy in line with SADC Frameworks and Strategies

➤ Eswatini Communications Commission Act 2013

The Swaziland Communications Commission Act empowered the Swaziland Communications Commission as an independent regulator in July 2013. It is now responsible for regulating and supervising the operations of electronic communications networks and the provision of electronic communications services in Swaziland, including the regulation of data protection in electronic communications. The Act transferred the regulatory powers and functions of Swaziland Posts and Telecommunication Corporation relating to communications, as provided under the Swaziland Posts and Telecommunications Act, 1983 to the Commission. The Commission regulates the Communications industry and may also advise government on policy and legislative measures, including radio and television broadcasts, postal services, electronic commerce and data protection in electronic communications. More information is available on the government website www.gov.sz

- Electronic Communications Act of 2013 (ECA): sets the tone for the transformation purpose of EPTC. gave EPTC exclusivity to construct, maintain and operate the national backbone infrastructure, which includes the international gateway. makes it compulsory for EPTC to create a subsidiary Telecoms Company that will operate in the retail space.
- Cyber Security Laws:

Swaziland is in the process of developing cyber security laws:

- Computer Crime and Cybercrime Bill, 2017: criminalise offences involving computers and network related crimes.
- Data Protection Bill, 2017: shall govern the collection, use, disclosure and care of personal data.
- The Electronic Communications and Transactions Bill, 2017: shall regulate electronic transactions and electronic communications, facilitate the use of e-government services and ensure the protection of consumers.

15.3 Current ICT Initiatives and projects

The Eswatini Government is currently developing a Science and Technology Park, called the Royal Science and Technology Park (RSTP), so that Swazis could have the opportunity to participate in the knowledge economy This park will create a Special Economic Zone (SEZ) to facilitate FDI as well as R&D facilities to facilitate the transfer of research results into the market place. The project started in 2007 with preliminary studies and eventually moved into the construction stage in 2012 starting with the Innovation Park. An area of 160 hectares is being developed for Biotechnology related industries with funding from the Republic of China on Taiwan. The Republic of China on Taiwan is also currently sponsoring the construction of computer laboratories in selected schools throughout Swaziland. This covers construction of the main structure, electrical installation, carpentry fitting and the computers to be used by the students.

The Innovation Park at RSTP is comprised of the following business units; National Data Center, Advanced School of Information Technology, National Contact Centre and the Information Technology Business Incubator. The aim of the Advanced School of IT is to provide world class ICT training, nurturing entrepreneurship through innovation and research, with world-class ICT facilities and specialized ICT courses.

The Information Technology Business Incubator (ITBI) enables creators to commercialize their innovations in the fields of computer, mobile phone, Internet and electronic products or processes through entrepreneurship. This is achieved through provision of access to working space and amenities, business and technical services, technology transfer services and network of mentors, collaborators and advisors to admitted start-ups. The ITBI also provides start-ups with access to networks of potential investors.

The National Contact Centre (NCC) is another business unit within the Royal Science and Technology Park, based at Phocweni in Matsapha. NCC is one of the many initiatives that is taking the country to the world class status. The National Contact Centre that offers world-class business process outsourcing solutions. The Centre seeks to address issues that arise from the rapid changes taking place in the business environment, by using the latest Innovative technologies for commercialization in the country.

The National Data Centre (NDC) provides IT Managed services through the provision of advanced technology infrastructure that will enable companies to outsource their ICT functions and services, thus focus the bulk of their effort and budget on the delivery of their core products and services.

Cyber Security and Forensics Research Group: The Eswatini National Cyber Security Strategy (NCS) 2022 (Strategic Goal 4) that fosters a safer and secure information society for Eswatini, the CSF Research Group will also consider involving its members in conducting research to assess the levels of cyber security awareness across Eswatini. Promoting End-user education (Awareness) on cyber security good practices across eSwatini

OVC Management Information System: which, through Eswatini MTN Mobile Money technology, ensures OVC beneficiaries receive their payment in a fast and reliable manner while cutting out the cost and inconvenience of having to go to town to receive the said money.

Elderly Social Grant System: which facilitates the payment of elderly and disability grants through the Eswatini Post Offices and banks and decreases the costs of sending and receiving cash for elderly people as the previous procedures proved expensive for the Eswatini Government.

Eswatini Agricultural Science Information System (SASIS): which is a system that collects data on Agricultural production while also providing functions on database administration, queries and reports

Electronic Document Record Management System (EDRMS): which will facilitate the collection of data that would assist the Government of Eswatini in the management of its records and

incoming mail. It will provide key features such as documents and content capture, workflow, document storage, document profiling, information searching and retrieval, check-in and check-out, version control, revision history, document security and electronic records management.

Government Wide Area Network (Microwave Technology): which will entail the installation of air fiber Wi-Fi backbone for government countrywide

Inpatient Information System: which is an internet based platform that captures the current diagnosis of patients at their exit of the health facility.

Development of a Parliament website: which will be an internet based platform that aims to provide a forum for Parliament and invited stakeholders to present their views on the contents and provisions of any subject under discussion in parliament.

Computerisation of Tinkhundla (Constituencies) Centres: Tinkhundla Centres are equipped to be utilised as central centres for e-Government Services which aims to provide infrastructure for communities to access government services from their constituencies.

15.4 National ICT Research Capacity and Priorities for Cooperation

15.4.1 National Priorities

National ICT Research Priorities include: eHealth, eAgriculture & Food Security, eInfrastructure, Environment, Entrepreneurship, eGovernment Services, CyberSecurity and Mobile computing.

15.4.2 National Research Capacity

There is one public university (the University of Swaziland) and four private institutions of Higher Education: The Southern Nazarene University, Limkokwing University, the Christian Medical University, which opened in August 2013 and Amadi. Limkokwing has Departments focused on ICT/Engineering but its research capabilities are still to be documented. In the Higher Education Sector the institutions that currently undertake research are the University of Swaziland (UNISWA) academic staff, the UNISWA Research Centre (URC) and the Swaziland Institute for Research in Traditional Medicine, Indigenous and Medicinal Food Plants (SIRMIP).

Outside the Higher Education sector, other institutions undertake research: the Agricultural Research Division of the Ministry of Agriculture, the Mathematics/Science and Prevocational Departments of the National Curriculum Centre of the Ministry of Education as well as the Energy Department and Department of Geological Survey and Mines both of which fall under the Ministry of Natural Resources & Energy. The Agricultural Research Division carries out research in support of national agricultural objectives and hence plays a very important role in socio-economic development.

The Swaziland Ministry of Health (MoH) established the Science and Ethics committee (SEC) with the mandate of reviewing and approving research protocols under the MoH. The National Research

Council is responsible for coordinating and commissioning all research in the country, including health research. ICAP and MOH partnered to build capacity in epidemiology and research and strengthen the monitoring and use of data to inform policy and programming. The scope of work included support for epidemiology, surveillance, research ethics, and the Health Research Training Program

Swaziland Health communication Capacity Collaborative (HC3) strengthens the capacity of national and regional coordination, local implementers and communities to prevent HIV through a community-led and owned process.

Swaziland Economic Policy Analysis and Research Centre (SEPARC) gives an opportunity to young and energetic researchers to practice professionally in the field of research. This is through mentorship and internship programmes (graduate intern) for professionals who want to develop their research skills and build their career in their respective fields.

15.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and additional information collected during the IST-Africa Horizon 2020 Training Workshop in November 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners include
eHealth	Health Information Systems/Electronic Health Records; Health diagnosis and Surveillance; Telemedicine and remote diagnosis; Logistics Supply Chain Management System; Integrated Response System	University of Swaziland (Department of Health Sciences, Department of Computer Science); Ministry of Health (Strategic Information Department - Research Unit); NGOs working in Health sector
eAgriculture	Early Warning Systems; Food Security; Livestock tracking; Drought resistance seeds; Sustainable Agriculture & Bio – Economy; Organic farming	University of Swaziland (Department of Agricultural Research); Ministry of Agriculture (Department of Agriculture and extension); Swaziland Economic Policy Analysis Research Center; Swaziland Environmental Authority; Swaziland Water & Agricultural Development Enterprise
eGovernment	Public Service Delivery; National Data Centre	University of Swaziland (Department of Computer Information Systems); Ministry of ICT; Royal Science and Technology Park
Environment	Water Conservation; Deforestation and	University of Swaziland, Swaziland Environmental

	soil erosion	Authority, Swaziland Water Services, Ministry of Natural Resources & Energy; Swaziland Institute for Research in Traditional Medicine, Indigenous and Medicinal Food Plants; Montigny
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Level of Research Maturity

The Higher Education Institutions are currently primarily focused on teaching. The general level of research maturity is limited to specific departments where staff members are undertaking research. There are specific institutions undertaking research focused on Agriculture and Energy. The country is currently focused on putting the necessary infrastructure in place and encouraging institutions to develop research capacity.

15.5 Innovation Spaces

The **Royal Science and Technology Park (RSTP)** was established with the enactment of the Royal Science and Technology Part Act of 2012 to assist in realising Vision 2022. Its partial operations began in October 2015 and will scale up its operations in the short term to medium term. The objective of the RSTP is to ensure that by 2022 Eswatini will be renowned internationally for her swiftness in exploring science, technology and innovation as a means to increase the country's economic growth and increase capacity by developing a knowledge-based economy and infrastructure thus substantially alleviating poverty. The RSTP has two science parks, the Innovation Park, located at Phocweni, Matsapha and the Biotechnology Park, located at Nokwane, Matsapha. The RSTP will provide a multipurpose platform for R&D, production, marketing and trading of IT and bio-related technologies. The RSTP has two sites, the Innovation Park, located at Phocweni, Matsapha and the Biotechnology Park, located at Nokwane, Matsapha. Both parks will incorporate entrepreneurship support services: pre-incubation, incubation and accelerator facilities for IT and biotech enterprises. RSTP began partial operations in October 2015 and will scale up its operations in the short term to medium term. The Innovation Park is collaborating with the Eswatini Investment Promotion Authority to identify potential investors for indigenous technology startups and promote a culture of entrepreneurship amongst local university graduates.

The RSTP has an IT Business Incubator (ITBI) and an Advanced school of IT (ASIT) housed within the Innovation Park at Phocweni. The aim of the IT School is to provide world class ICT training, nurturing entrepreneurship through innovation and research. The Advanced School of IT (ASIT) boasts of world class ICT facilities and it offers specialized ICT courses in Software Development, Multimedia, Cyber Security & Forensics and Hardworking & Networking. The Advanced School of IT (ASIT) is affiliated with Aptech. Aptech Limited is a global retail and corporate training solution's provider with a presence in more than 40 countries and a network of over 1300 training centres

worldwide. Aptech has an education partnership with universities including Middlesex, Portsmouth UK, RMIT Australia.

The Information Technology Business Incubator (ITBI) is focused on supporting entrepreneurs to commercialize innovations. Priority clusters include ICT, electronics, value-added agriculture, health and beauty, renewable energy and environmental management. This is achieved through provision of access to working space and amenities, business and technical services, technology transfer services and network of mentors, collaborators and advisors to admitted start-ups. The ITBI also provides start-ups with access to networks of potential investors and both fund raising and technical support. ITBI places a strong emphasis on protecting innovation and opportunities for recurring revenue and scalability.

The RSTP Biotechnology Park is focused on strengthening capacity in key areas including agriculture, plant, animal and medical biotechnology and biofuels, biofertilizers, biopesticides, biochemicals and bioenergy products;

The Central Bank of Eswatini in partnership with the RSTP, Eswatini Communications Commission (ESCCOM) and the Financial Services Regulatory Authority (FSRA) launched the **CBE Fintech Challenge**³⁹⁶ in 2018. Scope of Interest is oriented around a broad range of social challenges associated with unbanked citizens, remote verification of customers, digital payment solutions, affordable remittances, offline mobile payments, support for savings, insurance, borrowing and credit as well as solutions addressing regulatory requirements including cybersecurity. Twenty of eighty two applicants were shortlisted for a five day bootcamp addressing innovation, business planning, financial and telecommunications regulation and software develop to help them further developer their ideas. In 2019, three winners will be accepted into a twelve month RSTP Incubation Program with free office space and connectivity and a cash prize of SZL 16.600 (\$1,150) each.

³⁹⁶ <http://www.centralbank.org.sz/2018cbefintechchallenge/index.php>

16. REPUBLIC OF TANZANIA

16.1 Introduction

The United Republic of Tanzania is situated in East Africa, with borders with Kenya, Uganda, Rwanda, Burundi, Democratic Republic of Congo, Zambia and Mozambique. It has a surface area of 947,300 sq km, made up to 30 administrative divisions. The population is estimated at 55.451 million (2018, CIA World Factbook) with a literacy rate of 77.9%. 53.56% of the total population is between 15 – 64 years of age. Dar es Salaam has a population of 6.048 million (2018, CIA World Factbook). Dodoma is the official capital and home to Tanzanian Parliament, Government Ministries and major institutions, while diplomatic missions remain based in Dar es Salaam. Zanzibar has its own government and its own Ministry of



Education and several other ministries, which do not fall under union matters. The official languages are Swahili and English (primary language for business, Government affairs and Higher Education).

The Government of Tanzania recognises the importance of ICT and Innovation to support socio-economic development. Two of the three main policies supporting Innovation and Entrepreneurship have been reviewed in the past five years: updated Science Technology and Innovation (STI) Policy to incorporate Entrepreneurship and the national ICT Policy of 2003 as part of the development of a new implementation strategy - updated ICT Policy was approved in 2016.

In relation to Communications, according to the TCRA published statistics³⁹⁷, there were 125,616 fixed lines and 41,708 million mobile subscribers as of June 2018, with a teledensity penetration of 99% and internet penetration of 45% for 2017. Over Q3 2018 there has been a net addition of 1,490,172 telecom users, most of which through the two largest mobile operators in Tanzania: Vodacom (+587,908 users), and Tigo (+545,604 users). During the same period, Mobile Money Subscriptions (Mobile Money Accounts) reached 20,855,164 from 20,163,990 in April 2018. TCRA reported 22.995 million Internet users during 2017 compared with 19,562 million during 2016. The Internet penetration rate is 46%. There are currently seven Telecom providers: Airtel, Smart, Halotel, Tigo, TTCL, Vodacom and Zantel.

Mobile money applications are very popular for paying water/electricity bills and sending or receiving funds, with M-Pesa provided by Vodacom Tanzania, Airtel Money provided by Airtel, Tigo

³⁹⁷ TCRA Quarterly Communications Statistics Report, April- June 2018 Quarter

Pesa provided by Tigo, Halotel Money and Ezy-Pesa provided by Zantel. TCRA reported 20.28 million mobile money subscriptions as at June 2017.

The digital infrastructure in Tanzania has improved significantly with the fibre-optic network, investment in local Internet Exchange Points, migration to IPv6 and construction of the National ICT Backbone (NICTBB). NICTBB connected to SEACOM in July 2009 and EASSY in April 2010. There is extensive use of VSAT Internet, GSM, 3G, 4G, LTE and Microwave. These infrastructure improvements have assisted in reducing Internet access costs. The Government has introduced a Universal Communication Fund to facilitate telecommunications in rural areas. Tanzania had fully migrated from analogue to digital prior to the agreed deadline of June 2015.

National Internet Xchange Points (IXP) have been implemented since 2004 with funding from ITU. There are currently six IXPs located around the country (Dar es Salaam, Arusha, Mwanza, Zanzibar, Mbeya and Dodoma). A country level top-level domain has also been established. The national framework for Public Key Infrastructure (PKI) is being developed. There are more than 15 Tele-centres established, mostly funded by SIDA.

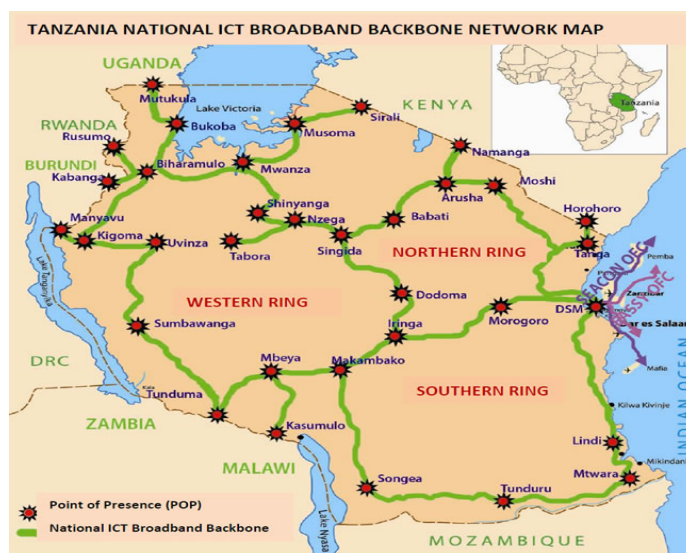
There are 11 public universities, 17 private universities and 26 private institutions of Higher Education.

16.2 ICT Background

The Tanzania Development Vision 2025 highlights the importance of leveraging ICT alongside the necessary skills and capabilities to realise a well-educated and learning society; and a strong, competitive economy capable of sustainable growth and shared benefits. The Tanzania Five Year Development plan 2011/12 to 2015/16 also highlighted the central role of ICT to support productivity.

The National ICT Policy (2003, revised in 2016) articulated ten main focus areas in harnessing ICT in Tanzania which include strategic ICT leadership; ICT infrastructure; ICT Industry; Human Capital; Legal and Regulatory Framework; Productive Sectors; Service Sectors; Public Service; Local Content; and Universal Access.

The Government established the Ministry of Communication, Science and Technology in 2008. Renamed the Ministry of Works, Communication and Transport in 2015, this Ministry is among other tasks, charged with the responsibility to create a conducive environment for investment, introduction



and use of ICT in national development efforts and government operations. A new Ministry for Education, Science and Technology was established in 2015.

The eGovernment Strategy was put in place in September 2012. The eGovernment Agency is responsible for the design and implementation of ICT enabled public services at a local and national level.

The rapid development of the telecommunications market means that the cost of owning and using digital equipment continues to decrease making ICTs increasingly accessible to the average Tanzanian. The ICT landscape is changing dramatically with the landing of the SEACOM and EASSY submarine cables on the East African Coast. The National ICT Backbone (NICTBB) is being constructed on the Optic fibre cable. The introduction of the fibre optic network through the NICTBB has reduced the cost of phone calls by nearly 40% in the past three years. NICTBB connected to SEACOM in July 2009 and EASSY in April 2010.

Tanzania liberalised the communications sector and established a regulatory authority under the Tanzania Communication Regulatory Authority Act No. 12 of 2003. Under Tanzania Communications Regulatory Authority (TCRA), a Converged Licensing Framework was introduced in 2005. The Licensing Framework consists of Network Facilities, Network Services, Application Services and Content Service Providers. The Application Service license relates to provision of electronic communications services to end users (e.g. Internet service providers, virtual mobile provider, payphone services, fixed/mobile service, financial services, Internet on mobile, eGovernment, eHealth or eCommerce services). TCRA has provided ICT Scholarships for bachelors, Masters and PhD candidates since 2011, with eight students sponsored in 2011, nine in 2012, with a goal to eventually support forty students. The Scholarships are advertised on a yearly basis with a deadline in August.

Under the Bilateral agreement between the Government of Finland and the Government of Tanzania through the TANZICT³⁹⁸ project the National ICT Policy of 2003 was reviewed and the National ICT Policy 2016 was approved in May 2016. It was formulated within the context of the Tanzania Development Vision 2025 and supporting a knowledge-based society. It aims to address opportunities as a result of improvements in eInfrastructure, reducing communication costs and migration to digital television broadcasting. It recognises the important role that the exploitation of ICTs can have on socio-economic development. It aims to: increase broadband access and penetration; improve ICT security and standardisation; enhance management and utilisation of spectrum; promote business process outsourcing; increase innovation via eServices and promote local content development. It also aims to establish frameworks for eWaste and to leverage ICT for disaster management and environmental conservation. This policy will be implemented by the Ministry for Works, Transport and Communication.

³⁹⁸ <http://tanzict.or.tz/>

16.3 Current ICT Initiatives and projects

ICT Initiatives are currently ongoing at national level in the areas of eInfrastructure and Education (Science, Technology and Higher Education Program, Tanzania National Research and Education Network, eLibraries, Education Management Information System), eHealth, Information Society & Entrepreneurship (TANZICT project, Dar Teknohama Business ICT Incubator, Binu Innovation Hub) and the Tanzania ICT Technology Park.

16.3.1 Science Technology and Higher Education Program (STHEP)

Science Technology and Higher Education Program (STHEP) was funded as a World Bank IDA loan of \$100 million to the Government of Tanzania, implemented through the Ministry of Education and Vocational Training (MoEVT) program with support from the Ministry of Communication Science and Technology (MCST). This was initially a seven-year program, which was approved in 2008 and divided into two phases of activities. APL1 activities were to be implemented within the first two years and APL2 activities were to be accomplished within the last five years of the program. The long-term purpose of STHEP was to improve development of human capital in area of Science and Technology (S&T) and create a knowledge-based economy within the next ten years. 128 Higher Education and Research Institutions (HERIs) were identified as being under the STHEP program.

STHEP had four program components: Component 1A – Investments in Priority Discipline for Economic Growth; Component 1B – Expanded capacity for Teachers preparation and for graduate's studies in education; Component 2A – Strengthening Key Higher Education Agencies and Institutions; Component 2B – Investments in ICT based Higher Education Systems. STHEP Component 2B was focused on four (4) major areas being; National Research and Education Network (NREN), Education Management Information system (EMIS), E-Library, and E-Learning. Shared mechanisms to support the implementation of Component 2B of STHEP have being established between all 128 HERIs under this program.

The final findings of the feasibility study for the development of E-libraries and EMIS was presented on 18th December 2012. The piloting of the e-learning system commenced in February 2013 with five Universities. The piloting for E-libraries and EMIS will be undertaken with eight institutions from February 2013.

In June 2014, the Program was extended for a further 18-month period with an additional loan of \$15 million to finish existing activities (\$6.37 million) and commence new activities to pilot reforms introduced by STHEP-1 related to secondary school science teachers and support the tertiary education system to be more responsive to the labour market demand. This project is now closed.

Funding agency: World Bank, IDA credit, \$100 million + further \$15 million

16.3.2 Tanzania National Research and Education Network (NREN)

Within STHEP, the Higher Education Research Institution Network was the infrastructure built by the Tanzanian Government. A major objective of component 2B was to set up TERNET³⁹⁹ in 2008 as the National Research and Education Network (NREN) to: better manage the increasing numbers of students as the education sector expands; improve the quality of data used in decision making and resource management; enhance knowledge sharing; improve transparency; improve classroom student-teacher participation; and improve research capability. It was envisaged that over time the NREN would enable HEIs (Higher Education Institutions (HEIs) and Research Institutions to link to the Internet and to exchange information between institutions. It also aimed to facilitate advanced teaching at Universities, research and Community services. It should help to alleviate the cost and isolation challenges currently faced by institutions and individuals in rural areas as well as linking the Tanzanian HEIs and research institutions to the international research and education networks. TERNET is a member of the Ubuntunet Alliance since 2008.

ICT Infrastructure

The Government of the United Republic of Tanzania through the Ministry of Works, Communication and Transport (MWCT) – the former MCST (Ministry of Communications, Science and Technology (MCST) built the National ICT Optic Fibre Cable (OFC) infrastructure Backbone (NICTBB). The NICTBB connects all district and regional headquarters in the country. The project officially started in February 2009.

Last Mile Connectivity

128 Higher Education and Research Institutions were identified to be connected through the NREN. Because of the limited funds available for phase 1 of the STHEP implementation, recommendations were made to connect only 28 higher education and research institutions in phase 1 and the remaining institutions to be connected in phase 2. By December 2018 23 Institutions have been connected.

ICT Applications

Building on the NICTBB and NREN, STHEP intended to implement both an Education Management Information System (EMIS) and an e-Library system to support education and research activities. The e-Library system includes both library management system (LMS) functionality, as well as digital library functionality, i.e. making digital content available for direct access by end users through digital technologies. The EMIS and e-Library systems may each consist of more than one software application.

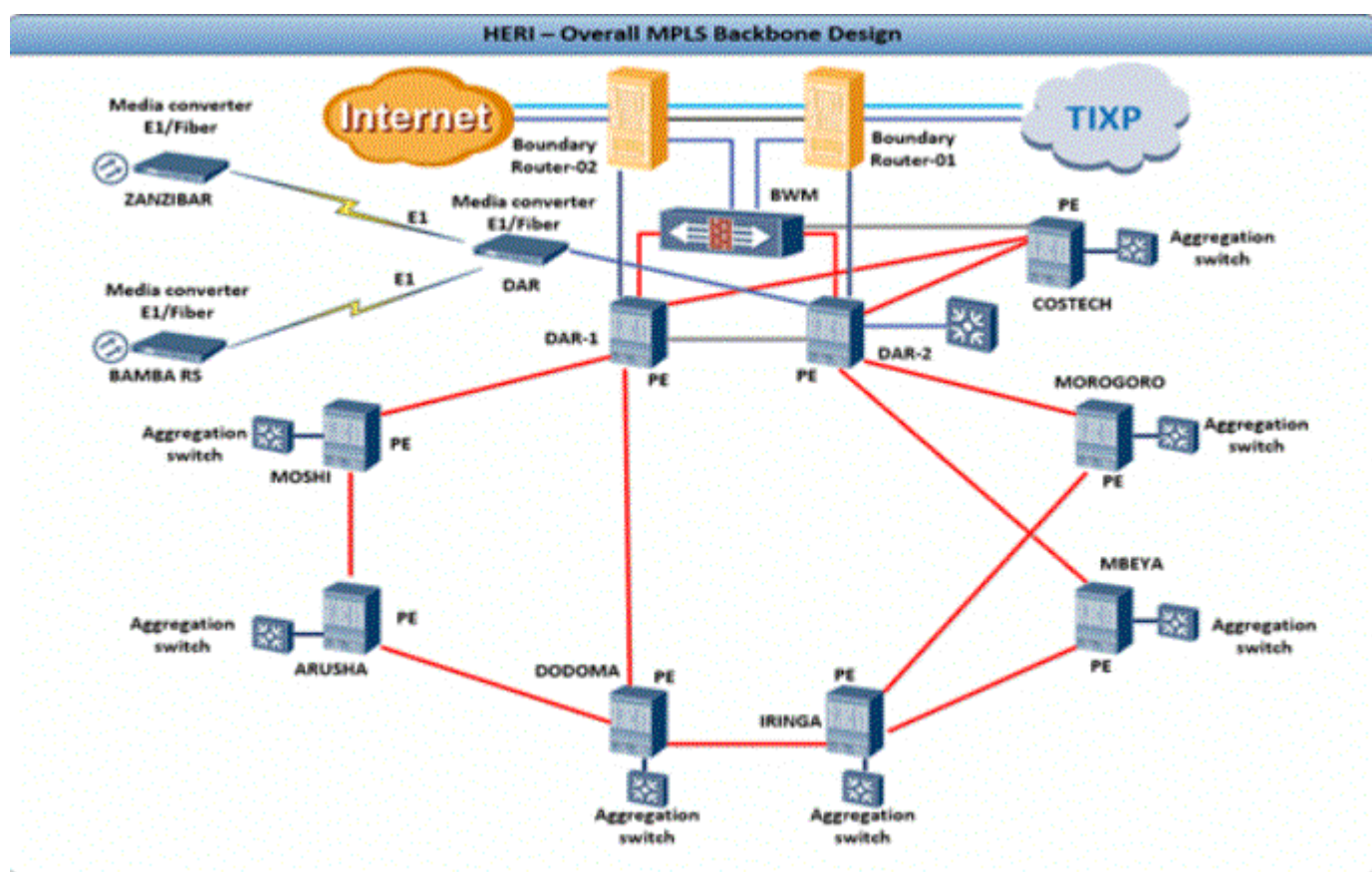
The piloting for E-libraries and EMIS was undertaken with eight institutions from February 2013. Individual consultants were hired by COSTECH to deploy EMIS and E-library systems. Eight

³⁹⁹ www.ternet.or.tz

institutions, including national agencies were selected as pilots for the EMIS system; five out of the eight institutions were pilots for the E-library system. The pilot institutions were Tanzania National Parks (TANAPA), University of Dar es Salaam (UDSM), Muhimbili University of Health and Allied Sciences (MUHAS), Mzumbe University (Morogoro Campus), State University of Zanzibar (SUZA), Tanzania Commission for Universities (TCU), Higher Education Student Loan Board (HESLB) and National Council for Technical Education (NACTE).

In addition to this, Tanzania Commission for Science and Technology has set up a National institution Repository⁴⁰⁰. The aim is to have one platform for research outputs. Currently Universities and other Research institutions have their own repositories. This new repository aims to provide access to all research outputs in one place. To date COSTECH, University of Dar es salaam and Mzumbe University have connected their repositories to the national repository. The aim is to connect up to 15 repositories.

Connectivity Arrangement



The HERI Core Network currently consists of 10 POPs which are located in different regions of the country: Dodoma, Dar-es-Salaam, Arusha, Moshi, Iringa, Mbeya, Morogoro, Zanzibar and Pwani. In Dar-es-Salaam there are two POPs, which are DSM/TH and Costech. Costech acts as a HUB of

⁴⁰⁰ <http://repository.costech.or.tz>

this Network. All connections shown in red represent the NICTBB fiber cable which is used to interconnect 90% of the POPs. Zanzibar and Pwani are connected to DSM/TH POP via E1

At each Regional POP, there is one PE router (Huawei NE40-X3) and one Aggregation switch (Huawei S5700) which can connect at least 24 HERIs (CE) of that particular region. Since Costech acts as a HUB of this Network, it serves as Internet Gateway, O&M Centre and also provide Internet bandwidth Management services.

The following institutions are connected: Nelson Mandela Institute of Science & Technology NM-AIST, High Education Students Loan Board (HESLB), Ardhi University (ARU), National Council of Technical Education (NACTE), Herbert Kairuki Memorial University (HKMU), Dar Es Salaam University College of Education (DUCE), National Education Council of Tanzania – HQ (NECTA), Muslim University of Morogoro (MUM), Tumaini University - Dar Es Salaam College (TUDARCo), School of Journalism and Mass Communication (SJMC), Mbeya University of Science and Technology (MUST), Dar Es Salaam Institute of Technology (DIT), Open University of Tanzania-DSM Campus (OUT-DSM), Open University of Tanzania-Kibaha Campus (OUT-Kibaha), International Medical & Technological University (IMTU), Ministry of Education and Vocational Training (MoEVT), Muhimbili University of Health and Allied Science (MUHAS), National Education Council of Tanzania – Mbezi (NECTA-Mbezi), Tanzania Commission for Universities (TCU), Saint John University of Tanzania (SJUT), Mkwawa University, College of Education (MUCE), Ruaha University College (RUCO), University of Iringa (UOI), Kilimanjaro Christian Medical College (KCMC), Moshi Cooperative University (MoCU), Stephano Moshi Memorial University College (SMMUC), Mzumbe University (MU), Sokoine University (SUA), State University of Zanzibar (SUZA), IFAKARA Health Institute (IHI), Economic and Social Research Foundation (ESRF), Tanzania Atomic Energy Commission.

Funding agency: World Bank

16.3.3 Connection of Teacher training Colleges and Technical and Vocational Institutions into the National ICT Broadband Backbone

The Ministry of Education, Science and Technology intends to fund the provision of network design services for the connection of Teacher training Colleges and Technical and Vocational Institutions into the National ICT Broadband Backbone project during the 2018 - 2019 financial year.

It aims to provide network design and technical assistance to MoEST in and endeavor to add a number of TVET institutions and TTC's into the existing HERI network by providing last mile connectivity and network access equipment to the colleges. It aims to

- i. Enable institutions to collaborate and share information through a single secure network. Resources available at one institution like e-library can be shared by other institutions thereby making full use of resources and prevent expensive duplication of resources;

- ii. Lectures and conferences offered at one institution can be shared in real-time with members of other institutions thereby making good use of the limited number of educators available at these institutions; and
- iii. Enable institutions to easily communicate with the general public and offer services such as online registration system.

It aims to connect teacher training colleges, TVET institutions across the country.

16.3.4 eHealth Strategy

In 2013, Tanzania launched the national e-Health Strategy (2013 – 2018) as an important milestone in the transformation of the healthcare system by ICT. It focuses on delivering a safer, high-quality, equitable, efficient, and sustainable health system that is equipped to respond to emerging health sector cost and demand pressures. A Digital Health Investment Recommendation Roadmap was developed through a consultative process with the Ministry of Health, President's Office Regional Administration and Local Government (PORALG), other Government departments and agencies, health management teams, health facilities and training institutes and partner organizations.

e-Health initiatives currently ongoing include:

a) e-Health infrastructure - The Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC), its MDAs, national, specialist, zonal and regional referral hospitals and district hospitals are connected to the National ICT Backbone.

b) Healthcare Service Provision - Work is ongoing on the integrated Health Facility electronic Management System (iHFeMS) at different levels covering various functions of the health facilities. i.e. National hospital, Zonal hospital, regional referral hospitals, district hospitals, health centres and dispensaries. It is now possible to determine who many patients a doctor has seen, patient confidentiality has improved, test results can be accessed quicker and decision-making processes have been improved through computerization of Health Management Information Systems (HMIS-MTUA). In January 2016 the Guidelines and Standard for integrated Health Facility electronic Management System (iHFeMS) was made available to standardise roll out.

c) Establishment of one source of facility information - The Health Facility Registry (HFR) System provides standardized health facility data (including unique identifier, geographical location, facility type, ownership, operating status, contact details, infrastructure and services provided by the facilities).

d) An electronic Logistic Information System (eLMIS) is used at national level to manage reports and requisition as well as distribution of health commodities

e) An electronic Integrated Disease Surveillance and Response (eIDSR) system has been introduced to collect epidemic prone and public health importance diseases from health facilities.

f) A telemedicine network has been piloted in seven health facilities named Amana, Temeke, Mwananyamala, Tumbi, Bagamoyo, Mbeya referral, and Muhimbili National hospital. The network is mostly used for tele-consultation from specialized hospitals to non- specialized hospitals.

16.3.5 eGovernment projects

In 2010 the Government established the eGovernment Agency to coordinate, oversee and promote eGovernment initiatives. A number of eGovernment systems have been deployed including the National Payment System (NPS) which comprises of the Tanzania Interbank Settlement System (TISS), Electronic Clearing House (ECH), Integrated Financial Management System (IFMS) and Retail Payment System (RPS). To date, the eGovernment agency has:

1. Designed, developed and operationalized the Government e-Office System (GeOS) to facilitate day to day Government administrative process within and amongst Public Institutions. Currently, 28 Public Institutions have been connected and are using the system.
2. Designed, developed and operationalized the Government Mailing System (GMS), to facilitate office communication whereby a total of 359 Public Institutions including Embassies are connected and using the System.
3. Facilitated designing and development of various e-government systems that facilitated public institutions business operations including PCCB corruption acts reporting system through short code 113, Parliament online information system POLIS, Government Recruitment portal that facilitated Government recruitment processes and Government e-Payment Gateway (GePG) to improve visibility, control of Government revenue collection
4. Established a secured and affordable shared Government Communication Network (GovNeT) to facilitate communication across the Government, whereby more than 150 Public Institutions are connected.
5. Developed and operationalised Government Mobile Platform (mGOV) as one stop center for all Government mobile services whereby, a total of 117 Public Institutions are using the Platform with more than 15 million transactions
6. Operationalised e-Government Standards and Guidelines used by Public Institutions to facilitate e-Government implementations. Moreover, the Agency is using them in providing guidance on proper acquisition and implementation of e-Government initiatives and reducing duplications.
7. Operationalised Government Data Centre that provide hosting services for virtual, websites, applications, co-location and domain registration and hosting
8. Provided advisory services to 299 Public Institutions and 2,947 technical support services in areas of ICT Systems Review, ICT Security Assessment, Development of Disaster Recovery Plan,

Development of ICT Strategy, Development of ICT Policy, Development of Enterprise Architecture and ICT Project Review.

9. Provided e-government technical trainings in areas of network management to 240 institutions, Government Mailing System to 359 institutions, provision of e-services to 76 institutions and website management to 411 institutions.

16.3.6 Innovation Projects

Finland has funded a number of projects in Tanzania focused on supporting the Innovation Ecosystem.

16.3.6.1 TANZICT

TANZICT⁴⁰¹ was an Information Society and ICT Sector development bi-lateral project between the Government of Tanzania and the Government of Finland, which is hosted by COSTECH from August 2011 to December 2016. It focused on strengthening the Tanzania Information Society through a revision of the national ICT Policy and associated Implementation, strengthening the institutional capacity of MCST and creating a Tanzania Innovation programme. It created a community spirit through support for pre-Incubation, training for women entrepreneurs, community events and hands-on support.

TANZICT set up an open Innovation Space and pre-Incubation space in October 2011 on the ground floor of COSTECH, which is now called Buni Hub. The Innovation Space provides co-working space with WiFi Internet access for up to 40 people, a meeting space for up to 60 people, regular training and networking events.

TANZICT co-operated with IIMC in relation to the second IST-Africa Living Lab Workshop⁴⁰² in Dar es Salaam in May 2012. TANZICT is providing hands on support to emerging Living Labs in Iringa, Kigamboni, Mwanza, Mbeya, Zanzibar and Arusha.

TANZICT launched the FEMTANZ 3-month Programme in December 2012 to provide business support training to women who wish to grow their own technology-enabled businesses.

TANZICT and DTBi launched joint Call for Pre-Incubation and Incubation.

TANZICT and COSTECH launched an ICT Innovation Fund in 2012 to provide seed funding to develop a prototype or pilot a service, which is managed by COSTECH and funded by TANZICT. The grant (\$7,000 - \$10,000) is focused on funding development of a prototype, technical work and technical skills but is not aimed at supporting the running costs of a start-up. It is a requirement that the recipient is hosted at an existing Incubator or Hub such as DTBI, Buni Hub, university incubator or KINU Innovation Hub that can provide mentoring and monitor their progress. The first Call for

⁴⁰¹ <http://tanzict.or.tz/>

⁴⁰² http://www.ist-africa.org/home/files/ISTAfrica2012_LivingLabsWorkingGroupMeetingReport.pdf

Applications closed in November 2012, received 25 applications with the first cohort of six grantees announced in April 2013 with funding of €50,000 in total. The second call received 44 applications with ten grantees announced in October 2014 and funding of €70,000 in total. The third Call closed in September 2014 and seven projects were funded. The fourth Call closed in May 2015 and received 137 proposals of which 18 innovators were awarded grants with a total funding of €155,000.

Funding: Government of Finland, 5 million euro (Sept 2011 – August 2015, extended to December 2016)

16.3.6.2 TANZIS

TANZIS was prepared as the follow on project from TANZICT focused on support to Tanzania's Innovation System. The overall objective of TANZIS is to support a "Functioning national innovation system in Tanzania contributing to companies' increased competitiveness, access to new markets and job creation". It is a cooperation between the Government of the United Republic of Tanzania and the Ministry for Foreign Affairs of Finland to intensify cooperation in the field of Innovation. Originally it was envisaged that this project would run from 2016 - 2021 but it has not commenced activities yet.

As outlined in the 2nd Five Year Development Plan (2016/2017-2021), Tanzania is embarking on economic and social development through industrialisation. The plan acknowledges that industrialisation and inclusive socio-economic development can only be attained through accumulation of national science, technology and innovation capabilities. The Ministry of Education, Science and Technology (MEST) has prepared a policy paper for Science, Technology and Innovation (STI) focused on highlighting the government priorities in STI. It will also lead to preparation of STI Act.

It has been determined that there are five main reasons why the innovation system in Tanzania does not function optimally which TANZIS aims to address: 1) lack of innovation policy; 2) lack of linkages between industry, academia and government; 3) inadequate funding to initiate and commercialise innovative ideas; 4) insufficient information on innovation, especially on successful innovations and 5) low innovation capacity and business skills or business understanding of SMEs, NGOs and funding agencies.

TANZIS aims to support the following outcomes:

- Enabling environment for innovation strengthened (immediate, system level);
- Sustainable results from actions on enabling environment for innovation (intermediate system level);
- Innovations created (immediate innovation level);
- Innovation projects produce economic and societal benefits (intermediate innovation level).

It has three components:

1. Increased opportunities for innovation through funding for innovation and cooperation through special innovation window in NFAST (here referred to as NFAST-I) and through skills development and capacity building (e.g. by supporting Living Labs or Team Academy activities).
2. Increased COSTECH capacity for fund management through capacity development, strategy and communication plan for NFAST-I; and
3. Increased information on innovation by advocating and raising awareness on the importance of innovation among policy makers, civil servants and general public.

It is envisioned that by the end of TANZIS, NFAST-I will be the most important source of innovation funding in Tanzania, with Tanzanian public and private financing, capable staff for fund management and an increasing number of innovators applying for funding.

Partners: Ministry for Foreign Affairs Finland (MFA), Ministry for Education, Science and Technology, COSTECH

Funding: €12.8 million, Ministry of Foreign Affairs Finland (70%), Government of Tanzania (30%)

It is envisaged that € 5.75 million (45%) will be allocated to finance innovation and cooperation, € 3.8 million (30%) will be used for international and national long-term and short-term technical assistance, € 3.2 million, (25%) to cover salaries of the Tanzanian staff and local expert, administrative costs and other costs such as office space, equipment and recurrent costs.

16.3.6.3 Southern Africa Innovation Support Programme (SAIS 2)⁴⁰³

SAIS 2 is focused on supporting the growth of new businesses through strengthening innovation ecosystems and promotion of cross-border collaboration between innovation players in Southern Africa. It is supported by the Ministry for Foreign Affairs (MFA) of Finland, in partnership with the Ministry of Infrastructure, Science and Technology, Botswana; Ministry of Higher Education, Training and Innovation (Namibia); Ministry of Education, Science and Technology, Tanzania; Ministry of Higher Education, Zambia; Department of Science and Technology, South Africa and the Southern African Development Community (SADC) Secretariat. It is supporting Sustainable Development Goals 4, 8, 9 and 17. It is focused on supporting institutional capacity to support innovation and enterprise development, improved enterprise capacity to innovate and enter new markets and an improved enabling environment to support inclusive innovation activities in the region.

SAIS2 is managed by a Programme Management office, hosted by NCRST in Namibia and implemented by focal points in Botswana, Namibia, South Africa, Tanzania and Zambia.

The SAIS2 Innovation fund publishes competitive Calls for proposals to award grants for locally implemented projects in the five partner countries. The first Call for Proposals ran from February to April 2018 with three funding opportunities focused on cross border projects to support development

⁴⁰³ www.saisprogramme.com

of institutional capacity for regional innovation cooperation; Scaling Enterprises through stronger Innovation Support organisations and Improving enabling environment for inclusive activities in the region. Four projects were selected for funding under each funding windows with twelve projects funded in total. The second Call for Proposals runs from November 2018 to January 2019.

SAIS 2 aims to support three capacity building programs for Innovation Fund grantees: Data Collection and Analytics Framework Training; Accelerator Programme for Entrepreneurs and Innovation Intermediaries and Inclusive Innovation and Capacity Building Program.

SAIS2 supported Connected Hubs to share best practices in innovation support through online and offline training sessions. In 2018 it organised the Annual Southern Africa Innovation Forum. Connected Hub Members during 2018 included Botswana Innovation Hub, Gen BW; National Commission on Research Science and Technology, Namibia; Namibia Business Innovation Institute; COSTECH, Tanzania; BuniHub, Tanzania; Technology Innovation Agency, South Africa; mLab, Southern Africa; National Technology Business Centre, Zambia and BongoHive, Zamiba.

National Focal Points: Botswana Innovation Hub (BIH), National Commission on Research Science and Technology Namibia (NCRST), Technology Innovation Agency, South Africa; COSTECH, Tanzania; National Technology Business Centre, Zambia

Funding: €9.3 million, Ministry of Foreign Affairs Finland 2017 - 2021

16.3.7 Tanzania ICT Technology Park

The ICT Technology Park, a Public and Private Partnership between the Government of Tanzania and SEACOM, will become a focal point for innovation, and include an Incubator providing co-working space, seed funding, training and mentorship for ICT entrepreneurs. Good progress has been made in identifying locations. The areas for the park has been confirmed in Bagamoyo and classified as a Special Export Zone, thus attracting low tax and tariffs, with SEACOM providing bandwidth. The data centre will be managed by NIDA as a 2 Tier data centre suitable for government, private sector and multinationals. The Park will help provide jobs by housing multinational enterprises and startup incubators, which will encourage them to interact.

Land has been acquired in the Bagamoyo Special Economic Zone. The total area is 428 acres. Cadeogeolostic and topographic surveys have been conducted as inputs for the Masterplan. A Detailed Master Plan for the Technology Park (TTP) has been developed by Voyants solutions of India. This includes Detailed Land use/layout plan for the whole technology Park and residential area; plots for industries, residents/recreational areas, Bagamoyo Institute of Technology and utility infrastructures. This part of assignment is 90% complete. Voyants submitted the final report of the master plan and currently they are working on comments from the advisory committee to final submission. The activity to formulate special Purpose Vehicle (SPV) to run the Technology Park effectively and efficiently will follow during 2019 - 2020

Funding: SEACOM and COSTECH

16.4 National ICT Research Capacity and Priorities for Cooperation)

In 2015/16 the Tanzania Commission for Science and Technology (COSTECH) produced the National Research Priorities for Tanzania to serve the research sector for five years i.e. (2015 – 2020). During the course of its implementation, the Commission realized that the document has some gaps that need to be filled based on the current trend of industrialization agenda. COSTECH is in the process of revisiting and updating the National Research Priorities for Tanzania 2015 - 2020. The revision features the importance of research and innovation in the industrialization policy and strategies in Tanzania. It incorporated comments from COSTECH stakeholders including heads of Higher Learning Institutions, Research & Development institutions and researchers. The validation workshop was held on 20th December 2018. Currently, the secretariat is working on the comments before the document could be forwarded to the approval authorities.

16.4.1 National Priorities

National Priorities include: eInfrastructures, Cloud Computing/ High Performance Computing, Cyber Security, Mobile Computing, ICT for Creativity and Learning, eHealth and eAgriculture.

- Cyber Security – To create a secure and safe cyber space for economic development. Institutions involved include: Institute of Financial Management, Dar es Salaam Institute of Technology, University of Dar es Salaam, State University of Zanzibar
- High Performance Computing / Cloud Computing – To improved industrial development and service delivery (data analysis, business intelligence, data mining and warehousing). Institutions involved include: Dar es Salaam Institute of Technology
- Mobile Computing and Mobile Apps – To support job creation and government service delivery. Institutions involved include: University of Dar es Salaam, University of Dodoma, Dar es Salaam Institute of Technology, Institute of Financial Management, State University of Zanzibar
- ICT for Creativity and Learning – Life long learning and the creation of a knowledge society and knowledge economy. Institutions involved include: University of Dar es Salaam, Dar es Salaam Institute of Technology, Institute of Financial Management, Open University

16.4.2 National Research Capacity

Based on a consultation process, the following Universities and research centres in Tanzania undertaking ICT-related initiatives have identified their areas of research expertise and track record. A summary of these findings are provided below:

➤ **University of Dar es Salaam**

- Depts include: School of Informatics and Communication Technologies⁴⁰⁴, College of Engineering⁴⁰⁵, University Computing Centre⁴⁰⁶
- Research focus includes: Computer Engineering and Computer Science, Technology-enhanced Learning, Mobile Computing, Cyber Security

➤ **University of Dodoma**⁴⁰⁷

- Depts include: School of Informatics
- Research focus includes: Informatics and Technology-enhanced Learning, Mobile Computing, Advanced Computing, Future Internet

➤ **Dar es Salaam Institute of Technology**⁴⁰⁸

- Depts include: Centre for ICT Excellence
- Research focus includes: High Performance Computing, Cyber Security, Mobile Computing, Technology-enhanced Learning, Future Internet

➤ **Institute of Financial Management**⁴⁰⁹

- Depts include: Computer Science, Information Technology, Centre for ICT Research and Innovations
- Research focus includes: Mobile Computing, Information Systems Security and Forensics, Technology-enhanced Learning

➤ **Nelson-Mandela Institution of Science and Technology**⁴¹⁰

- Depts include: School of Computational and Communication Science and Engineering (CoCSE) (Masters and PhDs) - Applied Mathematics and Computational Science (AMCS), Information Technology Development and Management (ITDM), Communication Science and Engineering (CoSE)
- Research focus includes: Energy, ICT, Environment and Water, Life Sciences and Bio-Engineering

➤ **Muslim University of Morogoro**

- Depts include: Information Technology
- Research focus includes: Data mining, Machine Learning, Pattern recognition, Technology-enhanced Learning

➤ **University of Bagamoyo**

⁴⁰⁴ <http://www.sict.udsm.ac.tz/>

⁴⁰⁵ <http://coet.udsm.ac.tz/>

⁴⁰⁶ <http://www.ucc.co.tz/>

⁴⁰⁷ <http://www.udom.ac.tz>

⁴⁰⁸ <http://www.dit.ac.tz/>

⁴⁰⁹ <http://www.ifm.ac.tz/>

⁴¹⁰ <http://www.nm-aist.ac.tz/>

- Depts include: ICT & Geo Informatics
- Research focus includes: Technology-enhanced Learning, eGovernment, eAgriculture, Cyber Law and Cyber Security
- **Ardhi University**
 - Depts include: Centre for Information and Communication Technology⁴¹¹
- **Open University of Tanzania**⁴¹²
 - Research focus includes: Environmental Issues; Agriculture & Food Security, Technology-enhanced Learning, ICT, Cyber Security, Health
- **Ifakara Health Institute**⁴¹³
 - Research focus includes: Health Sciences, eHealth, Health Information Systems
- **Muhimbili University of Health Sciences**⁴¹⁴
 - Research focus includes: Health Sciences, Health Informatics, Technology-enhanced Learning in the Health domain
- **Sokoine University of Agriculture**⁴¹⁵
 - Research focus include: eAgriculture, Food Security, eHealth, Data mining, Technology-enhanced learning
- **Mbeya University of Science and Technology**⁴¹⁶
 - Depts include: College of Engineering and Technology (CET), College of Science and Technical Education (CoSTE), Institute of Science and Technology (IST), School of Humanities and Business Studies (SHBS).
 - Research focus include: Technology/Applied Science, Climate Change and Environmental Issues, Food Production and Security, Business – Economics and Education
- **St John's University of Tanzania**⁴¹⁷
 - Faculties include: Humanities and Education, Commerce and Business Studies, and Natural and Applied Sciences), three Schools (Pharmacy and Pharmaceutical Sciences, Nursing, and Theology and Religious Studies), one Institute (Development Studies) and one Centre (Information and Communication Technology).
 - Research focus includes: E-Learning and Impact of Information Technology (IT) in higher learning Institutions

⁴¹¹ <http://www.aru.ac.tz/cat.php?id=25>

⁴¹² <http://www.out.ac.tz/>

⁴¹³ <http://www.ihl.or.tz/>

⁴¹⁴ <http://www.muchs.ac.tz>

⁴¹⁵ <http://www.suanet.ac.tz/>

⁴¹⁶ <http://www.mustnet.ac.tz/>

⁴¹⁷ <http://www.sjut.ac.tz/>

16.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and additional information collected during the IST-Africa Horizon 2020 Training Workshop in November 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Partners include
eHealth	Ifakara Health Institute; Muhimbili University of Health Sciences; Sokoine University of Agriculture; Catholic University of Health and Allied Sciences; Kilimanjaro Christian Medical University College
eAgriculture	Sokoine University of Agriculture; Agriculture Research Institute, Mbeya University of Science and Technology
Energy	Ardhi University (Departments of Geo Informatics, Geospatial Sciences, Environment Sciences, School of Geospatial Sciences & Tech-Gi&Gim); Nelson Mandela African University (NMIST) Arusha, Mbeya University of Science and Technology

16.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Advanced Computing	Dar es Salaam Institute of Technology: High Performance Computing University of Dodoma
Future Internet	University of Dodoma Dar es Salaam Institute of Technology
Content Technologies & Information Management	University of Dar es Salaam: Technology-enhanced Learning Institute of Financial Management: Technology-enhanced Learning Open University: Technology-enhanced Learning Muslim University of Morogoro: Data mining, Machine Learning, Pattern recognition, Technology-enhanced Learning Sokoine University of Agriculture: Data mining, Machine Learning, Technology-enhanced Learning University of Bagamoyo: Technology-enhanced Learning, eGovernment, eAgriculture, Cyber Law and Cyber Security Nelson Mandela University Arusha

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	Ifakara Health Institute: Health Sciences, eHealth, Health Information Systems Muhimbili University of Health Sciences: Health Sciences, Health Informatics Sokoine University of Agriculture: eHealth Catholic University of Health and Allied Sciences Kilimanjaro Christian Medical University College
Food Security, Sustainable Agriculture	Sokoine University of Agriculture: Sustainable Agriculture, Food Security Open University: Agriculture and Food Security Mbeya University of Science and Technology: Food Production and Food Security
Energy	Ardhi University Nelson Mandela Institute of Science and Technology
Transport	Ardhi University National Institute of Transport
Climate Action, Environment, Resource Efficiency and Raw Materials	Open University: Environmental Issues Mbeya University of Science and Technology: Climate Changes and Environmental Issues
Inclusive, Innovative and Reflective Societies	University of Bagamoyo: eGovernment
Secure Societies	Institute of Financial Management (Centre for ICT Research and Innovation): Information Systems Security and Forensics Open University: Cyber Security Dar es Salaam Institute of Technology: Cyber Security University of Bagamoyo: Cyber Law and Cyber Security University of Dodoma

Level of Research Maturity

Tanzania has good research capacity and a track record of collaborative research having participated in 40 projects and securing research funding of over **€12 million** under FP7.

Up to September 2018 Tanzania has been involved in 17 Horizon 2020 projects with research funding of over **€5 million** across a range of thematic areas:

- ENV, H2020-SC5-2014-two-stage- **AfricanBioServices** (RIA) - Sokoine University of Agriculture, Tanzania Wildlife Research Institute; University of Dodoma; University of Dar Es Salaam
- INFRA, H2020-INFRA-SUPP-2014-2 - **Sci-GaIA** (CSA) - Dar es Salaam Institute of Technology
- H2020-PHC-2015-single-stage_RTD - **EHVA** (RIA) - National Institute for Medical Research
- H2020-WATER-2015-two-stage - **VicInAqua** (RIA) - Science, Technology and Innovation Policy Research Organisation; **FLOWERED** (RIA) - Oikos East Africa; The Nelson Mandela African Institute of Science and Technology
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA) - Tanzania Commission for Science and Technology
- H2020-SC1-2016-RTD - **SURG-Africa** (RIA) - East Central and Southern Africa Health Community
- H2020-MSCA-RISE-2014 - **IMIXSED** (MSCA-RISE) - The Nelson Mandela African Institute of Science and Technology
- H2020-MSCA-IF-2014 - **ACTUS** (MSCA-IF-GF) - Ardhi University
- H2020-SFS-2016-2 - **InnovAfrica** (RIA) - Sokoine University of Agriculture
- H2020-JTI-IMI2-2015-08-single-stage - **PEVIA** (IMI2-RIA) - Ifakara Health Institute Trust
- H2020-NMBP-X-KET-2017 - **PITBUL** (RIA) - Dodoma Region
- H2020-MSCA-ITN-2017 - **ANTHUSIA** (MSCA-ITN-EJD) - National Institute of Medical Research
- H2020-ICT-2017-1 (ICT-39-2017) - **EPICA** (IA) - The Open University of Tanzania; **WAZIHUB** (IA) - Dar Teknohama Business Incubator Limited
- H2020-SC1-2017-Single-Stage-RTD - **UPSIDES** (RIA) - Ifakara Health Institute Trust
- H2020-SC5-2017-OneStageB - **MONOCLE** (RIA) - Tanzania Fisheries Research Institute

There is a strong policy focus (driven by COSTECH, MoEST and TCRA) on further strengthening the research capacity within the country, increasing the focus of research activities on their contribution to socio-economic impact, and facilitating the continued development of post-graduate programmes.

Tanzania Commission for Science and Technology (COSTECH) conveys an annual meeting to discuss STI indicators to determine current research being undertaken. Research Capacity is validated based on Number of Publications, Researchers, and the productions that are known locally or internationally.

16.5 Innovation Spaces

Innovation Spaces are now established across Tanzania, but often at different stages of development. Some are intended to be permanent and have at least some full-time employees, while others were established as part of projects and may not have a lifespan beyond the project duration. Finally, there are a few established by volunteers, primarily focused on skills development and supporting employment creation and these are often economically vulnerable.

In Dar es Salaam, while Buni Hub⁴¹⁸ is a pre-incubator (hosted by COSTECH), most innovation spaces are incubators (Cunningham et al 2014) including Dar Teknohama Business Incubator⁴¹⁹ (DTBi), the University of Dar es Salaam Entrepreneurship Centre (UDEC)⁴²⁰, UDEC Business Incubator⁴²¹, Research and Development Network (RDN) Hub⁴²² and University of Dar es Salaam ICT Incubator⁴²³ (UDICTI), Biashara Lab TAYOA⁴²⁴, Niwezeshe Lab/Nlab⁴²⁵, Energy Change Lab⁴²⁶, EQWIP Hubs⁴²⁷, TAREBI/IMED⁴²⁸, STICLab⁴²⁹, She Codes for Change⁴³⁰, Jenga Hub⁴³¹, Ndoto Hub⁴³², Hub 255, SmartLab⁴³³, Seedspace⁴³⁴, AMCET Hub, dLab⁴³⁵, Safe Space⁴³⁶ and Sahara Accelerator⁴³⁷.

There are also Innovation Spaces at different stages of development in Dodoma (Microsoft Innovation Center - MIC TANZANIA at University of Dodoma⁴³⁸, Arusha (Twende-AISE⁴³⁹, Kakute⁴⁴⁰, NM-AIST⁴⁴¹, Carmartec⁴⁴², Ubuntu Hub), Iringa (VSO International T-LED, Rlabs Iringa, Kiota), Moshi (Anza Accelerator, Kilihub), Mtwara (VSO International T-LED⁴⁴³), Mzanza (Saint Augustine University, Ellimu Living Lab Sengerema, EQWIP Hubs, VSO International T-LED) and Zanzibar (EQWIP Hubs, ZTBI, Cube Zanzibar, Tanzania Youth Icon (TAYI)).

⁴¹⁸ www.buni.or.tz

⁴¹⁹ www.teknohama.or.tz

⁴²⁰ <http://udec.udsm.ac.tz>

⁴²¹ <http://udec.udsm.ac.tz/incubation.html>

⁴²² www.rdnplatform.com

⁴²³ <http://udicti.coict.udsm.ac.tz/>

⁴²⁴ www.tayoa.org

⁴²⁵ www.niwezeshelab.org

⁴²⁶ www.energychangelab.org

⁴²⁷ <https://eqwiphubs.org>

⁴²⁸ <https://imedtz.org/renewable-energy-incubation-program/>

⁴²⁹ <https://sticlab.co.tz>

⁴³⁰ <http://shecodesforchange.org>

⁴³¹ <http://jengahub.com>

⁴³² www.ndotahub.com

⁴³³ <http://smartlab.co.tz>

⁴³⁴ www.seedspace.co/cities/tanzaniadaressalaam

⁴³⁵ <https://dlab.or.tz>

⁴³⁶ www.safespacetz.com

⁴³⁷ <https://saharaventures.com/saharaaccelerate.html>

⁴³⁸ <http://mictanzania.azurewebsites.net/>

⁴³⁹ www.twende-tanzania.org/about.html

⁴⁴⁰ <http://kakute.org>

⁴⁴¹ www.nm-aist.ac.tz

⁴⁴² www.camartec.go.tz

⁴⁴³ www.t-led.co.tz

Implementation of the Tanzania ICT Technology Park started in 2010 with an MOU signed with the Export Processing Zone Authority (EPZA) in May 2014. The Master Plan Development was completed in 2018 but a Special Purpose Vehicle to run the Technology Park has not yet started. The inauguration and Call for Investors for the Technology Park is planned for 2021/2022.

Some of these are profiled below. The Mara Launchpad Incubator opened in Q1 2013 and closed in 2014. KINU was launched as a pre-incubator and co-working space in 2012 and closed in 2016.

The Tanzania Commission for Science and Technology through Buni Innovation Hub have started an initiative to support the establishment and growth of innovation spaces specifically those attached in public universities in the country. The primary goal of this program is to create awareness in universities and R&D institutions about innovation spaces and guide them through the establishment of innovation spaces at their universities. It targets lecturers since they are the potential people to pioneer the establishment of these centers at the universities. The first phase included 6 universities and a total of 50 people who can potentially run the spaces, these includes: University of Iringa, Mbeya University of Science and Technology, University of Dodoma, Nelson Mandela Institute of Science and Technology, Sokoine University of Agriculture, State University of Zanzibar, Mwanza region – Innovation space and virtual incubator. In the second phase 14 universities will benefit from the programme.

Established in October 2011 within the TANZICT Bilateral project as an Innovation Space, **Buni Hub** is currently focusing on promoting innovation and technology entrepreneurship as a tech co-creation working space in Dar es Salaam. It is hosted by the Tanzania Commission for Science and Technology (COSTECH). The hub has also piloted the first makerspace in Tanzania, Buni mini fabrication laboratory which is under COSTECH. Buni Hub has a number of membership types:

- *Interns* - University students who are using Buni hub to work on various projects & ideas and most of them are registered to Buni Internship Programme (BIP);
- *Mentored Startups* - individuals with ideas or products who are looking to transform their ideas or products to early stage businesses they are part of the programme called Buni Mentorship Programme (BMP) which is more of a pre-incubation programme;
- *Makers* - individuals who are using Buni Mini Fabrication Laboratory to work on their different maker-tronics projects and ideas. Buni also hosts startups & freelancers individuals with their early stage ideas who are looking for the co-working space to work with their teams and meet with their clients. Buni offer shared resources for them to use free of charge.
- As part of Buni hub fourth programme *Buni Community Programme* (BCP), the hub conducts several community outreach activities aiming at nurturing innovations and technology entrepreneurship to Tanzanian youths.
- The BCP programme allows individuals interested to add value to the programme to register to Buni hub as *Buni Champions*.

COSTECH is the focal point in the Southern African Innovation Support Programme (SAIS 2), which is supported by the Ministry of Foreign Affairs Finland from 2017 - 2021. The SAIS2 Innovation Fund provides grants for locally implemented projects with partners from the beneficiary countries (Botswana, Namibia, South Africa, Tanzania and Zambia). COSTECH and BuniHub are members of the SAIS2 Connected Hubs.

STICLab⁴⁴⁴ is a makerspace established by a lecturer and students from Dar es Salaam Institute of Technology (DIT). The makerspace is called SticLab is a technology innovation centre that provides a futuristic technology development environment for scientists, makers and innovators. The center offers its users full access to lab and Workshop equipments that help them easily do their tasks, starting from idea conception to product and/or service development.

dLab (Tanzanian Data Lab) is an open working space funded by PEPFAR (President's Emergency Plan for AIDS Relief) and implemented by the Millennium Challenge Corporation (MCC). This is one part of the broader Data Collaborative for Local Impact (DCLI) Program, which is focused on promoting wider use of data analysis to inform decision making in Tanzania. dLab places a strong emphasis on the use of open data to inform societal oriented applications and provides training on data analytics and visualisation. Since 2018, it is also cooperating with Univesrity of Dar es Salaam on a Masters of Science in Data Science.

SmartLab was established by Smart Codes – a digital innovation and advertising agency providing solutions ranging from web and app development to social media strategies and media buying. They provide these services to those using SmartLab as well as access to mentorship and support and access to their customer network. SmartLab places an emphasis on building relationships with universities with a view to accessing graduates interested in establishing a business.

VSO International **T-LED (Tanzania Local Enterprise Development)** is a project supported by the Canadian government to support local SMEs (and particularly those led by women) in the Mtwara, Lindi, Mwanza and Iringa regions of Tanzania. It is funded by Global Affairs Canada (GAC) and delivered by VSO and Cuso International. As part of its objectives, T-LED will establish a competitive technology innovation fund that can be used to expand the technical capacity of business. Where possible technology will be procured from Technology Development Centres (TDC) organised by the Small Industries Development Organisation (SIDO) to manufacture equipment and technology locally to address local needs, thus strengthening the overall innovation ecoystem.

One of the innovation spaces in Arusha is called **Twende-AISE**. In 2007, Jim Elsworth established a workshop in Arusha, Tanzania called Twende (Swahili for "let's go") to identify local needs & engineer new technology solutions, empower entrepreneurs, offer business support, and encourage local innovation. Then in 2012, Bernard Kiwia began running trainings on design and innovation through an organization called AISE! (Swahili for "Wow!") which stands for 'Accelerating Innovation

⁴⁴⁴ <http://sticlab.blogspot.com/>

& Social Entrepreneurship' in Arusha. AISE! was focused on running creative-capacity building workshops, offering mentorship and advising to aspiring innovators, and continuing to invent his own life-improving products.

Twende and AISE! collaborated on a series of programs, culminating in the International Development Design Summit in 2014. IDDS Tanzania brought together 46 participants from 21 different countries to learn about the design process and apply it to create technologies in four rural communities in northern Tanzania. In only four weeks, the teams came up with eight prototypes and showcased them at the annual Nane Nane agricultural fair in Arusha. There was clear overlap between AISE! and Twende. Hence, in 2015, Bernard & Jim joined forces to work together to empower Tanzanians to design, develop, and disseminate life-improving technology solutions to the challenges they and their communities face. Twende-AISE activities are organized in two areas:

- **Workshop:** Twende-AISE have worked with over 1,300 secondary school students, small-holder farmers, women, and microentrepreneurs through their Innovation Workshops with over half female participation through a series of workshop. After a workshop ends, participants are given the opportunity to continue their projects. They provide funding, space, and technical advising to finish the first prototype to test.
- **Technology:** The Twende Core Team develops numerous prototypes a year. Some are selected for further refinement, going through an iterative design, technical testing, user testing, and redesign process (about 5-10 times), after which they begin producing & distributing. Some of the products that have been developed are:

Drip Irrigation Kit

This drip irrigation kit is an especially affordable product made from local Tanzanian parts. They use a combination of crop bags (gunia), plumbing pipes, wire coatings, and sheets of cut & soldered plastic to create an easy-to-use 7m x 4m drip irrigation kit .

Bicycle-powered Maize Sheller

The bicycle-powered maize sheller replaces hard manual labor by turning a common bicycle into a maize-shelling machine. With this machine, users can easily shell over 100 kg of maize per hour.

Research and Development Network (RDN) Hub is the Technology and Innovation Support Centers (TISCs) - Virtual Hub and Working Space, a private inniovation space established in 2016 in Dar es Salaam. Programs include:

- a) **Professional Connections/Networking:** It support Professional development, building strong business and working relationship, discovering and leverage talents to solve problems and increase productivity.

b) Innovation and Product development: It supports concept and product development, enhance innovative skills and Self confidence.

c) Virtual Assistance - Freelance service for research & Innovation: Virtual Assistants for entrepreneurs who are ready to delegate the doing so they can focus more on growing. It supports Problem solving on research and development for better achievement

d) Information sharing: It support awareness on innovation and entrepreneurship opportunities, events, and programs.

e) Graduates and students development: It support business and innovation skills development, enhance employability, and support connections with business partners and employers.

KIDT-VTC Ubunifu Hub is an Innovation spaces and technology transfer support centre located in Kilimanjaro Region, Moshi Urban district. This Ubunifu Hub is focused on encouraging innovation in ICT, Health and Education services in the interests of consumers by supporting innovators through allowing them access to working hubs, equipment, mentors & advisors as well as bringing consumer's requirements to them for development. Innovators have an opportunity to learn, as well as develop relevant products that are solving problems in the mentioned fields.

1. Identify skills needs in the sector and develop a practical, demand-driven training.
2. Provide appropriate facilities and infrastructure (ICT Centres of Excellence) which will house the training and hub program.
3. Linking up demand for solutions with the best innovator who gets engaged for that job
4. Invite the business communities to see different solutions developed by the innovators and how they can increase efficiency and profitability
5. Training to be delivered in two trenches: - (2-5 Days) Basic digital literacy and soft skill training - 3 months advance Coding Bootcamp (Target Beneficiaries include highly disadvantaged youth between the ages of 15-35 years old, living in Urban or Rural. The program explores the option of all-female cohort to mainstream gender.
6. Placed on technical skills (e.g., programming languages), soft skills relevant and entrepreneurship skills.
7. Upon training completion, beneficiaries will be awarded certificates. After which, the program will work with stakeholders to assist beneficiaries in obtaining internships or full-time roles.

Apart from mentor and supervision Hub organize exhibition, workshops and facilitators include and young stakeholders to be able to access all facilities and tools include computers and internet.

UDOM Innovation Space and Incubation Centre is the Innovation space and Incubation centre at the University of Dodoma, established based on support from COSTECH. The UDOM Innovation Hub aims to increase the contribution of higher learning institutions in attainment of economic

growth, reduction of poverty and improved social wellbeing of Tanzanians through increased access to Business Support System (BSS) offered as one package in innovation spaces and incubation centre.

The Hub facilitates and nurtures innovative ideas from students, staff and the community at large. The Hub is dedicated to support business start-ups, existing Micro, Small and Medium Enterprises (MSMEs) so as to create conducive enabling environment for job creation, business nurturing and growth. Their day to activities include:

- i. Offering professional development - support and training in different disciplines (like marketing, accounting and finance).
- ii. Knowledge provision on practical entrepreneurship and innovation courses.
- iii. Enhance and supervise entrepreneurial start-ups with necessary knowledge and skills (communication, advocacy, project management, negotiation etc).
- iv. Provision of facilities and technical support to Incubatees and shared support like administrative assistance, business legal advice.
- v. Motivating and aligning Incubatees efforts (mentoring and coaching).
- vi. Building networks with potential partners/
- vii. Organising and supporting (in terms of finance) exhibitions where students display and demonstrate their idea.
- viii. Encouraging and mentoring hub users to develop self-management skills.

DTBi was established in June 2011 with the support of COSTECH and infoDev together with local academia as an autonomous entity in a Public Private Partnership framework to grow and nurture emerging ICT start-ups/entrepreneurs. DTDi is currently supporting a total of 46 incubatees/entrepreneurs categorized as: 15 Graduated Companies, 8 Exist Incubatees and 23 Growth Companies.

Out of these, 8 are resident at COSTECH premise while 36 are supported virtually in Dar es Salaam, Mwanza, Mbeya, Kigoma Zanzibar and Moshi. DTDi collaborates with the Buni Hub in particular in supporting Pre-incubatees i.e. entrepreneurs that are still in ideation stage and as such Buni has become an important breeding ground of DTDi incubatees. Pre-Incubatees are provided with desk space and Internet access for three months while they develop their ideas.

They make a contribution of 50 USD per month towards operational costs or provide in kind services (management of network, website etc). It is expected that a prototype will be developed, company registration in place and to have started a marketing and business plan within this three month window.

DTBi also provides Incubation for companies – residential or virtual. There are specific criteria to qualify and residential incubates pay a subsidised rent per month. DTBi works on a Royalties model. DTBi provides loan guarantees for incubated companies with signed private sector or public sector contracts who need working capital. DTBi was the implementing partner for the InfoDev East Africa Virtual Incubation pilot launched in January 2013.

In June 2014, Tigo Tanzania signed a partnership with DTBi and COSTECH which aims to support 10 scholarships per year for Masters students, an internship programme and employment opportunities. Students who received such sponsorship are still working close to DTBi where they have been supported to come up with Ideas that can later on scaled up.

DTBi has assisted incubatees to generate more than US\$2.0 Million in annual turnover, and creating more than 520 direct and 12,400 indirect employment opportunities while the pre-incubation programs and app training for university students have served hundreds of youth. In addition, DTBi has forged strategic partnerships with reputable local and international organizations to enable smooth delivery of its services – TiGO Tanzania, Microsoft, Airtel Tanzania and National Economic Empowerment Council to mention just a few. Tigo – DTBi collaboration was signed in June 2014 dubbed as Project Digitize to accelerate digital inclusion in Tanzania. Through this collaboration 10 undergraduate and Masters students have been awarded scholarships in 2015/16 academic year and 2 new innovative solutions have been channelled to Tigo subscribers.

Further, DTBi in Collaboration with other partners and donors have implemented several other programs such as Data for Local Impact (DLI) which was a USD 4 Million dollar with the aim of promoting the use of data to come up with some innovative solutions that to solve some community challenges in the Health and Agricultural sectors. Under this program DTBi has manages to successful run 5 Innovation Windows and provided grants to 46 grantees ranging from individual, groups and companies.

DTBi in collaboration with other partners is currently implementing an 18 months program called Tanzania Digital Innovation Youth Empowerment Program. This Program has been funded by the Royal Danish Embassy with the aim enabling the Youth between 15-35 years old to take advantage of the opportunities that are provided by digital economy to create their own wealth and employment. The program has three main components i.e. provide online Entrepreneurship knowledge and skills, Optimal utilization of Kijitonyama Community Lab and Provision of Seed Funding to at least 20 people through Business Plan Innovation Challenge.

Lastly DTBi in Collaboration the Mwanza Regional Commissioner has been running Lake Victoria Challenge (LVC). The aim of this challenge is looking at the possibility of using innovation in drones in solving the challenge of untimely supply of medicines and other medical services as delivering of blood sample in the communities that are living in some Irelands such as Ukerewe. This program has originated from Drone-x program that was implemented by DTBi in collaboration with GIZ in Mwanza.

16.5 Technology Transfer and Development

Tanzania Commission for Science and Technology (COSTECH) at a national level has participated in the technology development and transfer. This includes:

i. Support establishment of virtual incubators in major cities

COSTECH in collaboration of the Dar Teknohama Business Incubator (DTBi) has supported the establishment of an Incubator in Mwanza city with the collaboration of Mwanza Municipal. In this incubator 6 start-up companies were established in the following areas: software development; mobile payment systems; microfinance, back-up & recovery. Initial activities have been carried out for the establishment of an Incubator in collaboration with the Arusha Municipality in Arusha.

ii. Support establishment of technology station for engineering and agro processing

In 2016 COSTECH in collaboration with the Ministry of Community Development and Empowerment in Zanzibar established the Zanzibar Technology Business Incubator (ZTBI) for ICT and Agro-processing. This incubator provides services to youth who has graduated in entrepreneurship training and it has 8 companies in agro-processing, 1 in ICT and 2 in Tourism. These has provided employment to the incubatees as well as enabled them to employ their youth fellows.

Initial preparations have been conducted including providing profiles of potential HEI and R&D institution for hosting the pilot Technology Station. In a workshop held in 2017, two areas for the TS were identified including engineering and agro-process. Experts from the Technology and Innovation Agency (TIA) conducted a workshop in Dar es Salaam in May, 2018 on Technology Station Concepts and visited the institutions to assess the potentials for hosting a pilot Technology Station. After the hosting institution has been identified a business plan for the TS will be prepared.

iii. Support establishment of Innovation Space

COSTECH has conducted trainings on the establishment and running of Innovation Spaces to 10 Higher Education Institutions. These trainings have led to the establishment of Innovation Spaces in the following universities: Tumauni University (Kiota Hub), Nelson Mandela African Institute of Science and Technology, Sokoine University of Agriculture (SUGECO), Dodoma University (UDOICT) and Zanzibar State University (SUZA), Mbeya University of Science and Technology (TISC). Trainings were also conducted in the following universities: Mzumbe University, Marian University-Bagamoyo, and University of Dar Es Salaam.

iv. Collecting information for STI indicators

COSTECH has developed an M&E (Monitoring and Evalution) framework with tools to collect information for STI indicators, COSTECH has entered into and MoU with the National Bureau of Statistics (NBS) to collect the information for the STI- indicators. Training has been conducted to collect the data as well as to focal persons in the HEI and R&D institutions who will provide the data to COSTECH annually.

v. Up scaling of research findings

From the 15 jointly funded research projects between 2011 and 2015, COSTECH in collaboration with the Technology and Innovation Agency (TIA) of South Africa, are funding 4 joint up-scaling projects resulting from the 15 completed projects in preparation for the commercializing of the research results.

vi. Promotion of Innovation initiatives at Local Government Authorities (LGA) through supporting SMEs, Clusters and startups

Through Sida funding, 15 clusters have been selected and baseline study conducted. A total of 177 Cluster stakeholders were sensitized on innovative clusters initiatives out of which 134 are males and 43 females (LGA, R&D institutions and cluster SMEs). Cluster facilitators were trained on cluster coordination and management while Cluster Research Model developed and validated. During 2017/18, monitoring and evaluation (M&E) framework have been developed and validated. An MoU between Small Industries Development Organization (SIDO) and Local Government Authorities (LGA) was signed and COSTECH and SIDO Staff (28m/10f) trained on cluster concept and coordination.

17. TUNISIA

17.1 Introduction

Tunisia is located in North Africa, in the eastern part of the Maghreb; bordered to the north and east by the Mediterranean Sea, to the south by Libya and to the West by Algeria; a crossroads between Europe on the one hand and the Middle East and Africa on the other hand. The name Tunisia is derived from its historic and economic capital, Tunis, located in the northeast and known as Carthage City. Tunisia has a surface area of almost 164,000 square kilometres (64,000 sq mi), made up of 24 governorates (administrative divisions). The population as at September 2018 was estimated at 11.686 million inhabitants with a literacy rate of 81.8% (CIA World Factbook). 67 percent of the total population is between 15 and 64 years of age. Tunis, the capital city, has a population of 1.067 million (2018, World Population Review). The official language is Arabic, and French and English are also fluently spoken.

Located on the south west of the Mediterranean Sea, Tunisia has a strategic location and is diversity in climate and natural environment. Its Mediterranean coasts: west – east in the north, and north - south in the east open a wide space for the movement of people and goods. Tunisia has 1,300 kilometres (810 mi) of coastline. The north and centre of the country consist particularly of fertile soil and the south of the country is composed of desert areas and fertile oases.

In Tunisia, education is given a high priority and accounts for almost 7% of GNP. Since 1991, a basic education has been compulsory for children between the ages of 6 and 16. Tunisia was ranked 17th in the category of "quality of the higher educational system" and 21st in the category of "quality of primary education" in The Global Competitiveness Report 2008-9, published by The World Economic Forum.

Tunisia has a developing economy. High quality tourist facilities are widely available in large urban and major resort areas. Tunisia has close social and cultural ties and economic cooperation agreements with Europe. Tunisian exports to the European Union market have consistently grown.

Tunisia considers the development of ICT in economic and social activities, administration, health, education, renewable energy and control of natural environments to be important. Tunisia endeavours to put the best ICT infrastructures in place to support economic growth, combined with highly qualified workforce to attract national and foreign investors in ICT and related technologies.



In terms of Communications, there are three main phone companies (Tunisie Telecom, Ooredoo and Orange) and one main Internet wholesaler (Agence Tunisienne de l'Internet⁴⁴⁵). Since January 2016, the three phone companies had direct access to the international Internet backbone. Based on statistics published by the Ministry of Communication Technologies and Digital Economy, there were 16.298 million mobile subscriptions as at September 2018, with teledensity (fixed and mobile) of 140.9 per 100 inhabitants. The total number of Internet subscriptions (fixed and mobile) was 9.8 million as at September 2018, with 8.059 million mobile Internet subscriptions, 765,201 mobile Internet subscriptions using a key and 977,724 fixed Internet subscriptions.

There are 13 public universities (more than 208 public Higher Education institutions, 38 public research centres) and 72 private institutions of higher education. Of these 30 have Departments focused on ICT/Engineering.

17.2 ICT Background

Tunisia has a good policy framework in place including the updated ICT Policy, eGovernment and eAdministration Strategy (2005) and National Development Strategies. Tele-centres exist in almost every town and village.

The Ministry of Higher Education and Scientific Research has highlighted that ICT and particularly the software industry, services and multimedia stand out as the main focus of Tunisia's ICT development strategy. The ICT sector is dynamic and is considered to be a priority sector with one of the highest growth rates (11% between 2007-2014, 7.7% between 2015 - 2016) and a 7.5% contribution to GDP. The ICT sector accounts for 20% of exports in the services sector and about 3% of total national exports. During the period 2007 - 2011 there was a growth in investment and profits derived from investments of about 6.3 billion dinars (3.03 billion Euro) compared with 430 million dinars during the period 1992-1996. This growth is as a result of better infrastructure and increased private sector involvement (5% between 1992 – 1996 to 40% between 2002 - 2006).

Tunisian software firms operate in the following fields:

- Strategic planning in communication and information systems
- Counselling in information systems and ICT: diagnosis, modelling, and re-engineering studies
- Engineering and software development
- Communication networks engineering
- Embedded systems integration
- Integration of communication or information systems (ERP, CRM, BI, Global Banking, solutions E-Business/e-Trade, Wide Area Networks of companies etc)
- Multimedia services engineering
- Data management

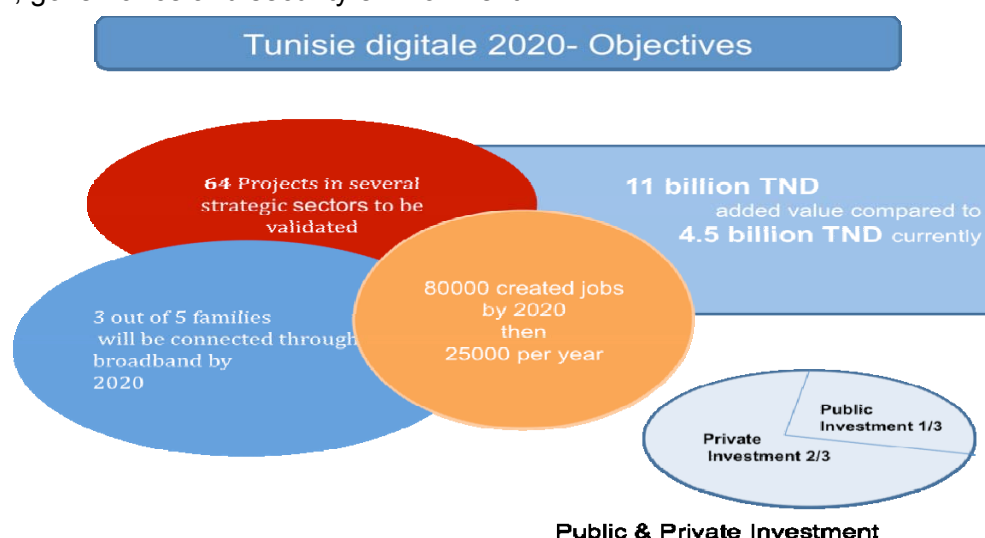
⁴⁴⁵ www.ati.tn

➤ Data base management or distant services application

In order to promote digital economy in Tunisia and to boost the digital transformation, in 2014 Tunisia established a strategic vision, called "Tunisie Digitale 2020", which aims to transform ICT an important enabler for socio-economic development. With a provisional budget of around 70 million Dinars for the period 2017-2020, the objective of the "Tunisie Digitale 2020" strategy is to develop a national platform offering a set of e-services (e-health, e-training, e-culture, e-tourism, e-commerce, etc.) for citizens, thus bridging social disparities. This vision also addresses job creation and sustainability through a qualitative leap in the ICT services industry in terms of added value and encouragement of innovation.

The main strategic axes of "Tunisie Digitale 2020" are:

1. Ensure social inclusion and reduce the digital divide through better access to information and knowledge, the democratization of access equipment as well as broadband access and implementation of very high-speed network.
2. Development of the digital culture through the widespread use of ICTs in educational curricula and the digitization of content.
3. Evolve towards an e-Administration in the service of the citizen, equitable, transparent, agile and efficient.
4. Ensure the reduction of unemployment and the creation of jobs in the digital and off-shoring sectors as well as the creation of national success stories.
5. Supporting the creation of added value, guaranteeing the sustainability of organizations and jobs, by supporting entrepreneurship and stimulating innovation.
6. Improve the competitiveness of the companies, across all sectors, by investment in ICT and positioning in the digital economy.
7. Ensure Tunisia's transition to all digital through the establishment of a suitable regulatory framework, governance and security environment.



The governance of this strategic vision is assured by a strategic national council chaired by the head of government, which involves the public and private sectors as well as the civil society, and which is supported by a steering committee chaired by the Minister of Digital Economy. The planned projects are allocated to departments in their respective areas of expertise.

17.2.1 ICT and Telecommunication infrastructure

Tunisia has a National backbone based on fibre optical cables that covers its entire territory and has multifunction high band switches that provide telephone transfer, Internet and multimedia.

Tunisia is connected to all its neighbouring countries and has optical fibre submarine connections to Europe, Asia, the Middle East and America. International Internet bandwidth capacity has grown from 50 Gb/s in 2010 to 225 Gb/s in May 2017. The interconnections has been secured by diversifying submarine cables (SEA-ME-WE4 and KELTRA 2), by diversifying landing points (Bizerte and Kelibia in Tunisia, and Marseille, Mazara del Vallo and Palermo in Europe), and also by installing its own submarine cable, Hannibal, with a capacity of 10 Gbps expandable to 3200 Gbps.

In terms of telecoms infrastructure available for professional and personnel use, Tunisia has:

- An Internet network covering the entire country, accessible through 11 Internet service providers (6 public and 5 private).
- A network of data transmission using various technologies: LS, ADSL, MPLS, SDH, dWDM, Frame Relay, VSAT, UMTS-HSPA++.

Tunisia started to exploit 4G mobile technologies in 2014. Three telecom operators, namely Tunisie Telecom, Orange and Ooredoo have tried to cover a large part of the population. Ooredoo has 70.4% coverage, compared to 68.9% for Orange and 63.4% for Tunisie Telecom. The average coverage is therefore 67.57%. Ooredoo is also leading in terms of 3G and 2G coverage, with figures close to 100%, indicating almost total coverage of Tunisia.

ATI⁴⁴⁶ (Agence Tunisienne de l'Internet - Tunisian Internet Agency), which operates under the Tunisian Ministry of Information and Communication Technology, was founded in March 1996 to promote Internet services in Tunisia. ATI is the wholesale provider of Internet services. It provides Internet access & services to various ISPs, and its roles include:

- The functions of a National Internet Exchange Point (national IXP) for the interconnection of ISPs to one another and the rest of the Internet; also provide Internet mail gateways service management for exchanging messages among themselves and with the rest of the internet
- Co-Management of the national domain ".tn" with the regulator
- Management of IP Addressing in Tunisia
- Promotion and Development of the Internet

⁴⁴⁶ <http://www.ati.tn>

17.3 Current ICT Initiatives and projects

ICT Initiatives are currently ongoing at national level in the areas of eInfrastructures (Technology Parks, Cyber Parks) and Support measures for Software companies and to set up ICT companies.

Smart Tunisia is a program for offshoring sector companies, with the ambitious goal of creating 50,000 jobs over the next five years in the areas of offshoring, the Nearshoring and collocation. Designed as part of a public-private partnership, "Smart Tunisia" responds to offshoring sector revitalization will, through the provision of incentive mechanisms for the implementation of supply and convergence demand for employment in the sector. The Tunisian government has allocated a budget equivalent to €500 million for 5 years in the form of incentives, to support international and local operators in their growth and development strategies of their activities. The objectives of "Smart Tunisia" include to create 50,000 jobs over the next 5 years; act as sole contact for the beneficiaries of the program companies and foreign investors who might be potential beneficiary; Making Tunisia the leader of the francophone offshoring and elevate Tunisia to the rank of offshoring hub and platform skills for Europe, Africa and the Middle East. The "Smart Tunisia" program finds its legal basis in Decree No. 2014-6 of 2 January 2014 which aims to promote offshoring activities in the field of Information Technology and Communication and the creation of a management unit.

In January 2017, the Ministry of Health launched the Digital Health (e-health) Development Initiative, which aims to provide health facilities in Tunisia with ICT tools. It aims to set up a digital platform leveraging information systems and telemedicine functionality. The first functionality will be used to facilitate the management of the patient flow and to improve their care by facilitating reception and transfers while ensuring traceability. The second feature is to consolidate sponsorship efforts between university hospitals and regional hospitals in inland areas. The objective is to provide physicians with telemedicine tools to assist the medical practitioner on site, as well as remote patient monitoring. This initiative has multiple benefits and will affect patients (better equality of care), health professionals (improving working conditions and reducing the load and displacement, the acquisition of new knowledge and the strengthening collaboration between professionals) and public authority (optimization of human resources management, maintenance of a health presence throughout the country and lower costs of care). From the many proposals received, the Ministry of Health selected five for funding.

The project	Project beneficiary
Telecardiology platform	University Hospital Center – Hedi Chaker- Sfax
Teleperinatality platform of the South	University Hospital Center – Hedi Chaker- Sfax
First Aid and Emergency Response in Cardiology	Regional Health Direction of Nabeul

Obstetric telechography platform	Maternity and Neonatology Center of Tunis
Teleradiology platform	Mohamed Kassab Institute of Orthopedics

All these projects will be launched in June 2019 due to financial resource constraints.

17.3.1 Initiatives and projects addressing Infrastructures for ICT companies

Tunisia is continuously developing innovative projects in heavy infrastructures for ICT sectors and related fields, as: technological parks, Poles of competitiveness and cyber parks.

17.3.1.1 Technology Parks

To support the development of companies and the launch of businesses with strong added value in terms of innovation, Tunisia established an ambitious program for the development of 10 technological parks. This program currently comprises three parks specializing in ICT:

- Digital Technology in Sfax;
- Nano and micro electronics in Sousse;
- Communication technologies in Tunis, in addition to an ICT component in all the other parks (bio-informatics).

This environment has fostered synergies between industry, research and educational universities. The technological parks have also promoted the emergence and development of innovative foreign and Tunisian companies.

The first technological park dedicated to ICT in Tunisia and North Africa, was Elgazala Technopole, which began its activities at the end of the 1990s. It accommodates over 90 companies employing 1650 people including 98% who are graduates. It also exports 75% of site production. Elgazala Technopole hosts some of the most prestigious multinationals such as Alcatel, Ericsson, Huawei Technologies, STMicroelectronics, Stone Soft, Kromberg Shubert and others. In order to meet an increasing demand, two additional sites will be annexed to Elgazala Technopole: Ennahli on 36 hectares and Manouba on 54 hectares.

17.3.1.2 Poles of competitiveness

Eight sectoral poles of national competence or regional competitiveness have been implemented to widen the sphere of activity of the technological parks and to reinforce the potential of sectoral innovation, clustering and development of technological partnerships and support company creation.

17.3.1.3 Cyber Parks

A network of cyber parks dedicated to providing on-line services was established across the entire country resulting in 14 cyber parks being in place by 2009.

17.3.2 Support for Investment in ICT

Tunisia has shown a significant interest in the development of ICT with concrete support to the development of the private sector, the environment, infrastructure and the legislative framework. Indeed, a set of incentives was set up and promoted Tunisia as a favourable site for the development of ICT.

17.3.2.1 Support for Setting up ICT companies

The main support programs are RITI, SICAR, BFPME, SOTUGAR, business incubators, etc.

- RITI⁴⁴⁷: funds capital risks with public participation for the promotion of entrepreneurial activities in ICT. In order to encourage the creation of innovative enterprises in the field of ICT, young Tunisian promoters holding university degrees may have access to the System of Incentives for Innovation in the Field of Information Technologies (RITI) for new projects. The RITI's share can be up to 49% of the project's capital; the promoter's contribution should be at least 2% of the project's capital.
- Private capital risk funds for ICT: Investment companies with Capital Risks (SICAR)
- Bank financing of SMEs (BFPME)
- Guarantee funds (SOTUGAR)
- CapitalEase, managed by UGFS, is a seed fund. CapitalEase invests at an early stage in exchange of equity and convertible bonds.
- A 10-year national plan for technological parks
- Network of 42 business incubators (2017): an incubator for every technological higher education/educational institution. These business incubators are networked through the "Business Incubators Network in Tunisia". There are three kinds of Business Incubators operating in Tunisian Incubators promoted by academic institutions, incubators operating under "Convention API / Universities" and Incubators backed to technoparks.
- A network of 14 cyber parks

A new law called "StartupAct", adopted in April 2018 by the assembly of representatives of the Tunisian people, aims the promotion of Tunisian startups by opening new perspectives and a range of benefits. In particular, the law "start-up Act" will allow companies and young people to solve the issue of financing through the creation, in 2019, of the Fund of funds endowed with an amount of 500 million Tunisian dinars (MDT).

17.3.2.2 Support for Software Firms

Support for Software Firms includes:

- Legislation specific to stock options in favour of ICT companies

⁴⁴⁷ <http://www.eriti.mincom.tn>

- Exemption of VAT on ICT training carried out by specialized companies
- Government subsidisation of 70% of the costs of certification of companies and competencies.
- Removal of the ceiling for travelling expenses abroad which are deductible from the wage bill subject to compliance with national insurance contributions

17.3.2.3 eGovernment Projects

Over the past decade, the Tunisian government has created a service portal for the benefit of citizens and businesses in various sectors, including health, finance, agriculture, education, transportation energy, etc. This portal⁴⁴⁸ contains more than 420 online services. Some services include:

1. **Tuneps** (www.tuneps.tn) is the national online public procurement management system. It ensures transparency, efficiency, equality of opportunity, efficiency and transaction security in the area of public procurement.
2. **E-jebaya** (www.impots.finances.gov.tn) is a tax filing service. It allows taxpayers to pay their taxes online. It allows also to pay monthly tax returns as well as annual returns, among others, filing of corporation tax returns, declaration of advance due by partnerships and similar, declaration of the personal income tax, declaration of installment, etc.
3. **Tasrih** (www.tasrih.tn): online declaration service of personal assets. This is an obligation for all citizens having a high fonction in the pubic sector, according to the law 46/2018 published on August 1, 2018 in relation with the declarations of the goods and the incomes, the struggle of the illicit enrichment and the conflict of interests in the public sector.
4. **E-Register** (www.registre-commerce.tn) : online service to extract the business register for businesses and individuals. It also allows to consult the history of companies and merchants, access the legal information registered in the Central Trade Register, access the financial statements to check the financial health of customers, suppliers, and partners, and download the statutes and balance sheets of Tunisian companies.
5. **DigiCash** is a mobile payment service downloadable from GooglePlay. It is a digital wallet backed by the e-Dinar service, which makes it possible to transfer money via mobile, instantaneously and securely, and to pay bills with the customer's digital wallet.
6. **6. Madrassati** : a mobile service for the benefit of pupils and parents enabling them to follow the notes and the presence of their children in schools and colleges via SMS. In addition, it facilitates administrative operations such as the removal of general assessment bulletins, timetables and student certificates.

⁴⁴⁸ <http://fr.tunisie.gov.tn/6-services-en-ligne.htm>

17.4 National ICT Research Capacity and Priorities for Cooperation

Tunisia invests in education and training to realise highly qualified human resources. Tunisia has made sustained efforts to improve its competencies and devotes nearly 17.87% of the state budget to education (Ministry of Education 13.74%, Ministry of Higher Education & Scientific Research 4.13%)⁴⁴⁹. This effort can be seen in the education statistics outlined below:

- 13 public universities and a virtual university
- More than 208 public higher education institutions and 72 private institutions of higher education
- There were 243,000 registered students at the end of 2017 (including 61% female)
- Almost 13,000 students in high standing European, Canadian and American universities
- Computerization and internet connectivity of all higher education institutions
- More than 40,797 students enrolled in ICT training – representing approximately 16.6% of the student population
- More than 10,762 ICT graduates per year (around 18% of total graduation)
- More than 151 ICT training specializations within more than 75 public and private higher education institutions

Tunisia regards the mastering of knowledge and technology as a crucial factor in economic and social development. The country is constantly consolidating investment in knowledge and adjusting the education system and training, to guarantee the competencies required by the workplace. It also aims at reinforcing the spirit of initiative, creativity and innovation. This effort has been the background for smart specialization, where a progressive and swift consolidation of scientific curricula and teaching material content in short and long term training courses of the higher education and vocational training institutions was carried out. This was based on:

- Cut-backs in training costs
- Intensive use of modern communication networks and the possibilities they offer
- Promotion of scientific research
- Languages: Arabic, French, English, German, Italian, Spanish and others

In addition to the investment in education, Tunisia is trying to enhance the quality of ICT companies. Conscious of the importance of certification of companies and competencies in order to guarantee a high quality of services and products and constant improvement, Tunisia engaged early in a program of ISO certification. Special programs of work certifications were also set up. This entailed a number of certified companies such as CMMI, ITIL and CISA. Thus, Tunisia has the first CMMI level 5 certified companies in Africa.

⁴⁴⁹ 2018 Tunisian State Budget

17.4.1 National Priorities

National ICT Priorities include to:

- Improve the eInfrastructure, Services and trusted Networks – to create new jobs, update ICT infrastructures and enhance the research and learning facilities. Institutions involved include: ENIT, University of Tunis El Manar; ENSI, University of Manouba; ENIS and ENET'Com, University of Sfax; INSAT, EPT and SupCom University of Carthage
- Promote the Knowledge Economy and eServices through the deployment of ICT (eHealth, eAgriculture, eLearning, eAdministration, eGovernment) and help the creation of new innovative SMEs and growth in existing SMEs. Institutions involved include: ENSI, University of Manouba; ENIS and ISIMS at the University of Sfax; SupCom, and INSAT: University of Carthage; ENSIT, University of Tunis; The Digital Research Center of Sfax.
- ICT for Energy Efficiency – development of Smart electrical grid and renewable energy use, enhancement of energy efficiency in transportation. Institutions involved include: ENIT, University of Tunis El Manar; ENSI, University of Manouba; ENIS and ISIMS at the University of Sfax; INSAT and SupCom University of Carthage; The Digital Research Center of Sfax.

17.4.2 National Research Capacity

The table below provides an overview of universities with ICT/Engineering Courses:

Institution	Location	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Total Students	Total ICT/students	Post-Graduate Masters, PhD
University of Tunis	Tunis	Higher School of Sciences and Techniques of Tunis	18	1160	136	178
University of Tunis El Manar	Tunis El Manar	Faculty of Mathematical, Physical and Natural Sciences of Tunis National School of Engineers of Tunis Higher Institute of Computer Science of El Manar	163	9395	2524	1243
University of Carthage	Carthage	Faculty of Sciences of Bizerte Tunisia Polytechnic School Higher School of Technology and Computer Science of Carthage National Institute of Applied Sciences and Technology Higher Institute of Applied Sciences and Technology of Mateur	163	7109	2125	577
University of Manouba	Manouba	Higher Institute of Multimedia Arts of Manouba National School of Computer Sciences	93	2184	1913	71

University of Jendouba	Jendouba	Higher Institute of Computer Science of El Kef Faculty of Juridical, Economic Sciences and Management of Jendouba	65	4527	1229	228
University of Sousse	Sousse	Higher Institute of Computer Sciences and Communication Techniques of Hammam Sousse National Engineering School of Sousse	73	1936	1312	128
University of Monastir	Monastir	Faculty of Sciences of Monastir National Engineering School of Monastir Higher Institute of Computer Sciences and Mathematics of Monastir Higher Institute of Applied Sciences and Technology of Mahdia Higher Institute of Computer Science of Mahdia ⁴⁵⁰	137	6307	2019	453
University of Kairouan	Kairouan	Higher Institute of Computer Science and Management of Kairouan Higher Institute of Applied Sciences and Technology of Kairouan Higher Institute of Applied Mathematics and Computer Science of Kairouan	69	2726	776	110
University of Sfax	Sfax	National Engineering School of Sfax Faculty of Sciences of Sfax Higher Institute of Electronic and Communication of Sfax Higher Institute of Computer Science and Multimedia of Sfax	217	7294	2242	991
University of Gafsa	Gafsa	Faculty of Sciences of Gafsa Higher Institute of Applied Sciences and Technology of Gafsa Higher Institute of Sciences and Energy Technology of Gafsa	46	3393	547	169
University of Gabes	Gabes	Faculty of Sciences of Gabes National Engineering School of Gabes Higher Institute of Computer Sciences and Multimedia of Gabes Higher Institute of Applied Sciences and Technology of	141	6422	1484	256

⁴⁵⁰ www.isima.rnu.tn

		Gabes Higher Institute of Industrial Systems of Gabes Higher Institute of Computer Sciences of Medenine				
Higher Institute of Technological Studies	Tunis	Department of Computer Sciences	609	25541	5880	0

The following universities and research centres in Tunisia are undertaking ICT-related initiatives:

- **University of Tunis**⁴⁵¹ - Higher School of Sciences and Techniques of Tunis
 - Research focus: e-learning, image and video processing, signal processing, embedded systems, WSN, wireless communications, Encryption;
- **University of Tunis El Manar**⁴⁵²
 - Faculty of Mathematical, Physical and Natural Sciences of Tunis: Algorithmic and heuristic programming; Parallel algorithms and data analysis
 - National School of Engineers of Tunis (ENIT): Coding, transmission and protection of information; Microwave and antennas; Guided optics and integrated cellular radio networks, Networks and Systems, Embedded communicating Systems; audio Tattoo; Energy efficiency – smart grids, home grids, transport; Optical Communication systems; Photonic crystal structures – solar cells; Parallel Computing and Simulation Software; eHealth; Self-management of health; Smart cities; Smart electricity Grids; Smart Metering; Big Data, Machine Learning; Advanced Data Mining
 - Higher Institute of Computer Science of El Manar: Software Engineering and Information Systems, systems architecture and networks; industrial computer science;
- **University of Carthage**⁴⁵³
 - Faculty of Sciences of Bizerte⁴⁵⁴: Computer sciences
 - Tunisia Polytechnic School⁴⁵⁵: Optical, Microwave and wireless networks and systems;
 - Higher School of Technology and Computer Science of Carthage (ESTI) ⁴⁵⁶: Computer Systems and Software, Network Management and Services;
 - National Institute of Applied Sciences and Technology (INSAT) ⁴⁵⁷: Optimization of Wireless Networks of the future; Internet of things; Operation and management of large volumes of

⁴⁵¹ www.utunis.rnu.tn

⁴⁵² www.utm.rnu.tn

⁴⁵³ www.ucar.rnu.tn

⁴⁵⁴ www.fsb.rnu.tn

⁴⁵⁵ www.ept.rnu.tn

⁴⁵⁶ www.esti.rnu.tn

⁴⁵⁷ www.insat.rnu.tn

data; Interoperability between hardware and software components; Supercomputing; Dependability and Development of safe systems with high time constraints; Robotics, Mobile networks and computing; Smart Embedded Components and Systems, Smart Integrated Systems, Systems of Systems and Complex System Engineering, Processor and System Architecture, Interconnect and Data Localisation Technologies, High Performance computing, Future Internet, Cloud Computing, Cyber Security, Privacy and Trust, Technology-enhanced Learning, Content Access and Analytics; Big Data Technologies, Advanced Data Mining, Machine Learning, Service Robotics, eHealth; Smart cities;

- Higher School of Communications (Sup'Com) of Tunis⁴⁵⁸: ICT for Environment (disaster management, flood mapping, forest fires etc), Communications – Signal and Image, Biomedical Audio/image analysis. Signal and image, Smart Embedded Components and Systems, Technologies for IoT, Processor and System Architecture, Networks, Software and Services, Cloud Computing, Future Internet, Cyber Security, Privacy and Trust, Wireless Communication and All Optical Networks, eHealth; Self-management of health; improved diagnostics; health data collection; Sustainable Agriculture and Forestry; Smart cities; Energy Efficient buildings; Smart electricity Grids; Smart Transportation
- **University of Manouba**⁴⁵⁹
 - National School of Computer Sciences (ENSI) ⁴⁶⁰: Internet of Things (IoT) Communications Machine-to-Machine (M2M) & Internet ubiquitously, Green Communications, Smart Grid Communications, Social Networks, Interconnection and cooperation cyber physical systems heterogeneous CPU-GPU Hybrid Calculations wide scale optimization, reasoning by constraints and quality of service in networks techniques cache to minimize network traffic in applications using streaming media, network quality of service oriented MANETs; Software engineering, Documental engineering; Linguistics engineering; engineering of knowledge and information
- **University of Jendouba**⁴⁶¹
 - Faculty of Juridical, Economic Sciences and Management of Jendouba⁴⁶²: Computer sciences
- **University of Sousse**⁴⁶³
 - Higher Institute of Computer Sciences and Communication Techniques of Hammam Sousse: Engineering of knowledge and information

⁴⁵⁸ <http://www.supcom.mincom.tn>

⁴⁵⁹ www.uma.rnu.tn

⁴⁶⁰ www.ensi.rnu.tn

⁴⁶¹ www.uj.rnu.tn

⁴⁶² www.fsjegj.rnu.tn

⁴⁶³ www.uc.rnu.tn

- National Engineering School of Sousse⁴⁶⁴: Industrial computer sciences
- Higher School of Sciences and Technologies of Hammam-Sousse⁴⁶⁵
- **University of Monastir**⁴⁶⁶
 - Faculty of Sciences of Monastir: Digital systems and computer sciences
 - National Engineering School of Monastir
 - Higher Institute of Computer Sciences and Mathematics of Monastir
 - Higher Institute of Applied Sciences and Technology of Mahdia
 - Higher Institute of Computer Science of Mahdia
- **University of Kairouan**⁴⁶⁷
 - Higher Institute of Computer Science and Management of Kairouan⁴⁶⁸
 - Higher Institute of Applied Sciences and Technology of Kairouan⁴⁶⁹
 - Higher Institute of Applied Mathematics and Computer Science of Kairouan
- **University of Sfax**⁴⁷⁰
 - National Engineering School of Sfax (ENIS)⁴⁷¹: Computer sciences, Signal processing; High Performance computing, Future Internet, Robotics, Mobile networks and computing, Smart Embedded Components and Systems, Parallel Computing and Simulation Software, Cloud Computing, Wireless Communication, Technology-enhanced Learning, Advanced Data Mining, Smart cities; Smart electricity Grids; Smart Transport
 - Faculty of Sciences of Sfax⁴⁷²: Computer sciences
 - National School of Electronics and telecommunication⁴⁷³: Networking, Computer Engineering, Medical Electronics, Smart-Grid
 - Higher Institute of Computer Science and Multimedia of Sfax⁴⁷⁴: Multimedia and computer sciences
- **University of Gafsa**⁴⁷⁵
 - Faculty of Sciences of Gafsa⁴⁷⁶

⁴⁶⁴ www.eniso.rnu.tn

⁴⁶⁵ www.essths.rnu.tn

⁴⁶⁶ www.um.rnu.tn

⁴⁶⁷ www.univ-k.rnu.tn

⁴⁶⁸ www.isigk.rnu.tn

⁴⁶⁹ www.issatkr.rnu.tn

⁴⁷⁰ www.uss.rnu.tn

⁴⁷¹ www.enis.rnu.tn

⁴⁷² www.fss.rnu.tn

⁴⁷³ www.isecs.rnu.tn

⁴⁷⁴ www.isimsf.rnu.tn

⁴⁷⁵ <http://www.ugaf.rnu.tn/>

⁴⁷⁶ www.fsgf.rnu.tn

- Higher Institute of Applied Sciences and Technology of Gafsa
- Higher Institute of Sciences and Energy Technology of Gafsa
- **University of Gabes**⁴⁷⁷
 - Faculty of Sciences of Gabes⁴⁷⁸
 - National Engineering School of Gabes⁴⁷⁹
 - Higher Institute of Computer Sciences and Multimedia of Gabes
 - Higher Institute of Applied Sciences and Technology of Gabes
 - Higher Institute of Industrial Systems of Gabes
 - Higher Institute of Computer Sciences of Medenine
- Virtual University⁴⁸⁰: E-learning

17.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders the following thematic areas are considered to be important in the context of the ICT-39 Call:

Thematic Areas	Topics	Partners include
eHealth	Telemedicine and remote diagnosis, Wireless devices for healthcare; Disease Treatment and Management; Medical Image Process, mHealth	Institut Pasteur de Tunis; Centre de Recherche en Numérique de Sfax; Neurone Institute; Salah Azaiez Institute of Cancer Studies; ISI, University Tunis El Manar; ENIT, University Tunis El Manar; ENSIT; ENIS; ENET'Com, SupCom; Institut National de La Sante Publique;
eAgriculture & Environment	Water management; eAgriculture, Precision Agriculture	INAT Carthage University; ENSI, Manouba University; IRESA; INSAT; ENIT; Institut National des Sciences et Technologies de La Mer; SupCom; Ecole Nationale d'Ingénieurs de Sfax, Centre de Recherche en Numérique de Sfax
Technology-enhanced Learning	Distance Learning; Access to computational grids	Université Virtuelle de Tunis; CCK; ENSI, University of Manouba; INSAT, University of Carthage; SupCom; ATI; CERT
eGovernment	Service Delivery	CNI; ENSI, University of Manouba; INSAT, University of Carthage; ENIS; ENSIT; Université Virtuelle de Tunis
Environment		ENIT, ENIS, Centre International des Technologies de L'environnement de

⁴⁷⁷ www.univgb.rnu.tn

⁴⁷⁸ www.fsg.rnu.tn

⁴⁷⁹ www.enig.rnu.tn

⁴⁸⁰ www.uvt.rnu.tn

		Tunis; SupCom; Institut National Agronomique de Tunisie; Observatoire du Sahara et du Sahel; Centre de Biotechnologie de Sfax - CBS; Centre de Biotechnologie de Borj Cedria; Centre de Recherches et des Technologies des Eaux; Université de Tunis; Sfax University; Institut des Regions Arides
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17.4.4 Mapping to H2020 Themes

The mapping to Horizon 2020 Research areas is summarised below:

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	<p>SupCom (Dept. of Computer Science and Networks and Doctoral school of ICT): Smart embedded components and systems</p> <p>ENSI (Dept. of Embedded Systems and Networks and Security Systems): Smart embedded components and systems, technologies for IoT</p> <p>ENIS (Dept. of Department of Computer Sciences and Applied Mathematics): Smart Embedded Components and Systems, Technologies for IoT, Smart Integrated Systems, Systems of Systems and Complex System Engineering</p> <p>ENET'Com (Department of Computer Engineering) : Embedded Components and Systems, Smart-Grids, Medical Electronic</p> <p>Center for Research in microelectronics & nanotechnology: Processes, Micro Nano Sensors and Systems</p> <p>Digital Research Center of Sfax: medical electronics, sensors, Technologies of IoT, Embedded systems.</p>
Advanced Computing	<p>ENSI (Dept. of Information Systems and Decision): Processor and system architecture, cloud computing</p> <p>INSAT (Dept. of Computer Sciences and Mathematics): cloud computing, parallel computing and simulation software</p> <p>SupCom (Dept. of Computer Science and Networks and Doctoral school of ICT): Processor and system architecture</p> <p>ENIS (Dept. of Computer Sciences and Applied Mathematics): Processor and System Architecture, Interconnect and Data Localisation Tech, Parallel Computing and Simulation Software.</p> <p>Digital Research Center of Sfax: Cloud Computing, Parallel Computing, Computer Vision, Augmented Reality, Virtual Reality</p>

Future Internet	<p>SupCom (Dept. of Computer Science and Networks and Doctoral school of ICT): Networks, Software and Services, Cloud Computing, Cyber Security, Privacy and Trust, Wireless Communication and All Optical Networks</p> <p>ENSI (Dept. of Embedded Systems and Networks and Security Systems): Networks, Software and Services, Cloud Computing, Cyber Security, Privacy and Trust, Wireless Communication and All Optical Networks, Immersive Interactive Multimedia</p> <p>ENIS (Dept. of Computer Sciences and Applied Mathematics): Networks, Software and Services, Cloud Computing, Cyber Security, Privacy and Trust, Wireless Communication and All Optical Networks</p> <p>INSAT (Dept. of Computer Sciences and Mathematics): Networks, Software and Services, Cloud Computing, Cyber Security, Wireless Communications and All Optical Networks</p> <p>ENIT (Dept. of ICT): Networks, Software and Services, Cloud Computing, Cyber Security, Wireless Communications and Optical Networks</p> <p>University of Tunis (Higher School of Sciences and Techniques): Wireless communications, image and video processing, signal processing</p> <p>ENIS (University of Sfax): Signal processing, Cloud computing, Wireless Communications</p> <p>Digital Research Center of Sfax: Remote Sensing, Internet of Things, Wireless Communication, Information Centric Networks</p>
Content Technologies & Information Management	<p>ENSI (Dept. of Information Systems and Decision): Technology-enhanced Learning, Content Access and Analytics; Big Data Technologies' Advanced Data Mining, Machine Learning</p> <p>ENIS (Dept. of Computer Sciences and Applied Mathematics): Technology-enhanced Learning, Content Access and Analytics; Big Data Technologies' Advanced Data Mining, Machine Learning</p> <p>University of Tunis (Higher School of Sciences and Techniques): Technology-enhanced Learning</p> <p>Digital Research Center of Sfax: Big Data Analytics, machine Learning, Deep learning</p>
Robotics	<p>ENSI (Dept. of Embedded Systems and Networks and Security Systems): Service Robotics, Advanced Interfaces</p> <p>ENIS (Dept. of Electrical Engineering): Service Robotics, Advanced Interfaces</p> <p>Digital Research Center of Sfax: medical robotics</p>

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	<p>ENIS (Dept. of Computer Sciences and Applied Mathematics): eHealth; Self-management of health; improved diagnostics; health data collection; Active Aging, Independent and Assisted Living; Methods and Data;</p> <p>SupCom (Dept. of Applied Mathematics, Signals and Communications): eHealth; health data collection</p> <p>ENSIT (Dept. of Electrical engineering and computer Sciences): eHealth; Self-management of health</p> <p>Institut Pasteur de Tunis</p> <p>Institut National de La Sante Publique</p> <p>Digital Research Center of Sfax: Monitoring of Patient, Telemedicine, Medical Image Processing, Health Informatics, m-Health</p>
Food Security, Sustainable Agriculture	<p>SupCom (Dept. of Applied Research): eSustainable Agriculture and Forestry;</p> <p>INSAT (Dept. of Computer Sciences and Mathematics): Management of water resources in arid regions</p> <p>ENIT (Dept of ICT): Management of water resources in arid regions.</p> <p>Institut National des Sciences et Technologies de La Mer</p> <p>Institution de La Recherche et de L'enseignement Supérieur Agricoles Centre de Biotechnologie Borj Cedria</p> <p>Institut National Agronomique de Tunisie</p> <p>Ecole Nationale de Médecine Vétérinaire</p>
Energy	<p>ENIS (Dept. of Electrical engineering): Smart cities; Smart electricity Grids; Smart Metering; Low-Cost, New Knowledge and Technologies</p> <p>SupCom (Dept. of Electronics, Physics and Propagation): Smart cities; Energy Efficient buildings; Smart electricity Grids;</p> <p>ENSI (Dept. of Embedded Systems, Networks and Security Systems): Smart cities; Smart electricity Grids; Smart Metering; Low-Cost, New Knowledge and Technologies</p> <p>ENSIT (Dept. of Electrical engineering and computer Sciences): Smart cities; Smart electricity Grids; Smart Metering; Low-Cost, New Knowledge and Technologies</p> <p>Alternative Energy Systems SARL</p>

	Ecole Nationale d'Ingenieurs de Tunis Digital Research Center of Sfax: Smart-Grids, Smart-Cities
Transport	ENSI (Dept. of Embedded Systems, Networks and Security Systems): Smart Transport Equipment, Infrastructures and Services; Innovative Transport Management Systems ENIS (Dept. of Electrical engineering): Smart Transport Equipment, Infrastructures and Services; Innovative Transport Management Systems ENSIT (Dept. of Electrical engineering and computer Sciences): Smart Transport Equipment, Infrastructures and Services; Innovative Transport Management Systems
Inclusive, Innovative and Reflective Societies	ENSI (Dept. of Information Systems and Decision): Digital Inclusion; Social Innovation Platforms, eGovernment Services, eSkills, eLearning, eCulture ENIS (Dept. of Computer Sciences and Applied Mathematics): Digital Inclusion; Social Innovation Platforms, eGovernment Services, eSkills, eLearning, eCulture ENSIT (Dept. of Electrical engineering and computer Sciences): Digital Inclusion; Social Innovation Platforms, eGovernment Services, eSkills, eLearning, eCulture Université Virtuelle de Tunis: Technology-enhanced Learning

Level of Research Maturity

Tunisia has a strong research base and track record having participated in more than **87** projects and securing over **€13.4 million** in research funding under FP7.

- INFRA, H2020-INFRADEV-1-2014-1 - **ARISE2** (RIA) - Centre National de la Cartographie et de la Teledetection
- H2020-SC5-2015-one-stage - **GEO-CRADLE** (CSA) - Centre D'etudes et de Recherches de telecommunications)
- H2020-INT-SOCIETY-2015 - **MedReset** (RIA) - Faculte de Droit et des Sciences Politiques de Tunis
- H2020-WATER-2015-one-stage - **WaterWorks2015** (ERA-NET-Cofund) - Institution de la Recherche et de L'enseignement Superieur Agricoles
- H2020-SFS-2015-2 - **SALSA** (RIA) - Institut National de la Recherche Agronomique de Tunisie
- H2020-NMP-2015-two-stage - **MIDES** (IA) - Ecole Nationale D'ingenieurs de Gabes

- H2020-WATER-2015-two-stage - **MADFORWATER** (RIA) - Faculty of Sciences of Tunis, University of Tunis el Manar; Institut Supérieur de Biotechnologie de Sidi Thabet
- H2020-WATER-2015-two-stage - **FLOWERED** (RIA) - Observatoire du Sahara et du Sahel
- H2020-INT-INCO-2015 - **5TOI_4EWAS** (CSA) - Chambre de Commerce et D Industrie du Centre; Ministry of Higher Education and Scientific Research; Agence Nationale de Protection de L'environnement
- H2020-SC5-2016-OneStageA - **4PRIMA** (CSA) - Ministry of Higher Education and Scientific Research
- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA) - Ministry of Higher Education and Scientific Research
- H2020-MSCA-RISE-2016 - **trans-making** (MSCA-RISE) - Forum Tunisien pour les Droits Economiques et Sociaux
- H2020-MSCA-RISE-2016 - **IPM-4-Citrus** (MSCA-RISE) - Centre de Biotechnologie de Sfax - Cbs; Institut Pasteur de Tunis; Centre Technique des Agrumes; Wiki Start-Up; Les Laboratoires Medis
- H2020-SC6-REV-INEQUAL-2016 - **DARE** (RIA) - Sfax University
- H2020-SFS-2016-2 - **MedAID** (RIA) - Institut National des Sciences et Technologies de la Mer
- H2020-SwafS-2016-1 - **InSPIRES** (RIA) - Institut Pasteur de Tunis
- H2020-BG-2016-2 - **ODYSSEA** (RIA) -Regional Activity Center for Specially Protected Areas; Association Nationale de Développement Durable et de la Conservation de la Vie Sauvage
- H2020-EEN-GA-2017-2018-1 - **H2020 WP2017-2018** (CSA) - Agence de Promotion de l'Industrie et de l'Innovation
- H2020-SFS-2016-2 - **PALE -BLU** (RIA) - Institut Pasteur de Tunis
- H2020-SEC-2016-2017-1 - **PRACTICIES** (RIA) - Associatio Forum des Sciences Sociales Appliquées ; Présidence du Gouvernement
- H2020-MSCA-RISE-2016 - **CURE-XF** (MSCA-RISE) - Institut National de la Recherche Agronomique de Tunisie
- H2020-MSCA-ITN-2014 - **EUROLEISH-NET** (MSCA-ITN-ETN) - Institut Pasteur de Tunis
- H2020-MSCA-RISE-2014 - **TROPSENSE** (MSCA-RISE) - Institut Pasteur de Tunis
- H2020-MSCA-RISE-2015 - **MediHealth** (MSCA-RISE) - Faculte des Sciences de Sfax
- H2020-MSCA-RISE-2015 - **EXANDAS** (MSCA-RISE) - Centre De Biotechnologie De Sfax - Cbs
- H2020-SFS-2017-1 - **ForestValue** (ERA-NET-Cofund) - Institution de la Recherche et de L'enseignement Supérieur Agricoles
- H2020-MSCA-COFUND-2016 - **BITRECS** (MSCA-COFUND-FP) - Institut Pasteur de Tunis
- H2020-SFS-2017-1 - **AfriCultuReS** (RIA) - Observatoire du Sahara et du Sahel

- H2020-BG-2017-1 - **CLAIM** (IA) - Institut National des Sciences et Technologies de la Mer
- H2020-RUR-2017-1 - **INCREDible** (CSA) - Institut National de Recherches en Genie Rural, Eaux et Forets
- H2020-MSCA-RISE-2017 - **bTB-Test** (MSCA-RISE) - Institut Pasteur de Tunis
- H2020-SC5-2017-OneStageB - **WaterWorks2017** (ERA-NET-Cofund) - Institution de la Recherche et de L'enseignement Superieur Agricoles; Ministry of Higher Education and Scientific Research
- H2020-MSCA-RISE-2017 - **EMERTOX** (MSCA-RISE) - Institut National des Sciences et Technologies de la Mer
- H2020-MSCA-RISE-2017 - **LeiSHield-MATI** (MSCA-RISE) - Institut Pasteur de Tunis
- H2020-SFS-2017-2 - **BRESOV** (RIA) - Universite de Tunis el Manar
- H2020-RUR-2017-2 - **LIVERUR** (RIA) - Dar Margoum Ouedhref
- H2020-SwafS-2017-1 - **R-I PEERS** (CSA) - Agence Nationale de la Promotion de la Recherche Scientifique
- H2020-ECSEL-2017-2-RIA-two-stage - **SECREDas** (ECSEL-RIA) - Ecole Nationale D'ingenieurs de Tunis; Ecole Superieure des Communications de Tunis
- H2020-LCE-2017-RES-IA - **SUPER PV** (IA) - Agence Nationale pour la Maitrise de L'energie
- H2020-SCC-NBS-2stage-2017 - **EdiCitNet** (IA) - Association Tunisienne de Developpement Durable: la Recherche en Action; Commune de Carthage
- H2020-WIDESPREAD-05-2017-Twinning - **PHINDaccess** (CSA) - Institut Pasteur de Tunis
- H2020-WIDESPREAD-05-2017-Twinning - **FASTER** (CSA) - Institution de la Recharge et de l'enseignement Superieur Agricoles, Institut National de Recherches en Genie Rural, Eaux et Forets, Agence de Vulgarisation et de la Formation Agricoles
- H2020-SPACE-2018 - **S4Pro** (RIA) - Ecole Nationale d'Ingenieurs de Gabes

Tunisia has a mature program of research in ICT topics involving a large number of institutions and research laboratories and post-graduation programmes that involve universities and ICT companies. A good indicator of this strong scientific activity is the number of scientific publications, international projects and patents issued by these research activities. Tunisia has a program of cooperation with several institutions in neighbouring countries, European countries, North American and other countries. This cooperation has facilitated the development of research projects that involves foreign research organizations and local and international companies. These activities have provided a forum for mutual knowledge of potential RDI operators of telecommunications networks, structures for ICT research, the major companies operating in the sector. Tunisia is positioning itself as a main regional hub for the Mediterranean region in ICT research and

development activities. Tunisia supports structures for innovation and foreign partners to build relationships and partnerships and prepare for calls to RDI projects in ICT in Tunisia.

17.5 Innovation Spaces

In 1999 Tunisia launched a national programme to establish business incubators⁴⁸¹ within Higher Education Institutions supported by Ministry of Higher Education and Ministry of Industry. The first incubator commenced operations in 2011. There is now a network of 26 incubators across the country located in Higher Institutes of Technological Studies (ISET), engineering schools, research centres and science parks.

Tunisia has also established a **Centre for Innovation and Technological Development (CITD)** as a support structure within the Agency for Promotion of Industry and Innovation. Its mission is to assist companies in their innovation efforts by providing relevant advice, high value services and assists them to identify technological innovation requirements.

Tunisia is a member of the Enterprise Europe Network since 2010.

Innovation Spaces in Tunisia are relatively recent and include *WIKI Start Up*⁴⁸², *Reseau Entreprendre Tunis*⁴⁸³, *Microsoft Innovation Center*, *Stanford Peace Innovation Lab*⁴⁸⁴, *Elfabrika*⁴⁸⁵, *Fablab ENIT*⁴⁸⁶, *Tunis Fablab*⁴⁸⁷, *Fablab Solidarity Youth Science Tunisia*, *IntilaQ*⁴⁸⁸, *Flat6Labs*⁴⁸⁹ *Tunis*, *B@Labs*⁴⁹⁰, *Cogite*⁴⁹¹, *Factory 619*⁴⁹² and *COStart*.

Some profiles are shared below.

Established in 2011 in Tunis, the **WIKI Start Up Business Incubator** focusing on helping entrepreneurs get from proof of concept to implementation through the provision of technical assistance, tailored coaching and other resources. Services offered at different stages include Venture Catalyst Services, Venture Fundraising Services and Business Development Services. WIKI Start Up and Carthage Business Angels organised a series of Innovation Workshops in 2013 and WIKI Start Up runs an annual UNIVENTURE competition for potential research spinoffs.

Established in 2012, **Reseau Entreprendre Tunis** (and Monastir) is part of Reseau Entreprendre International, an association of local business owners and entrepreneurs. Mentoring is available from experienced entrepreneurs, as well as monthly group training to build capacity and networks.

⁴⁸¹ <http://www.tunisieindustrie.nat.tn>

⁴⁸² <http://www.wikistartup.tn/>

⁴⁸³ <http://www.reseau-entreprendre-tunis.org/>

⁴⁸⁴ <http://peaceinnovation.stanford.edu/field-lab-network/tunis/>

⁴⁸⁵ <http://elfabrika.tn/>

⁴⁸⁶ www.facebook.com/FabLabENIT

⁴⁸⁷ www.fablabtunisia.com

⁴⁸⁸ www.intilaq.tn/

⁴⁸⁹ www.flat6labstunis.com/

⁴⁹⁰ www.biatlabs.com/

⁴⁹¹ <https://www.cogite.tn/>

⁴⁹² <https://factory619.com/>

Microsoft Innovation Center (MIC) is partnership between the Tunisian Government and Microsoft aimed to support the development of the software industry in Tunisia, stimulating innovation and entrepreneurship by developing intellectual capital and strengthening industrial partnership. The center aims to strengthen the competitiveness of enterprises in information technology by providing access to the latest technology.

The **Fablab Solidarity Youth Science Tunisia** was launched by Orange-Tunisia and the Association of Young Science. It is a digital fabrication shop. It is equipped with several 3D printers, laser cutting, vinyl cutting, a digital milling machine, a 3D scanner, open source software design to assist ideas to be transformed into prototypes. It supports innovation and provides the tools to entrepreneurs, researchers, designers, students, students, artists and young people without qualifications and / or unemployed.

There were also other FabLabs established in recent years including FabLab ENIT and Tunis FabLab Tunisia.

Launched in April 2014, **IntilaQ** is an initiative of Microsoft, Qatar Friendship Fund (QFF) and Ooredoo. It consists in an Innovation and Business Hub that aims to provide the best business creation environment in Tunisia, by being the leader in innovation in the field of ICT, and the destination of choice for researchers, jobs and young entrepreneurs. Since its creation IntilaQ has helped to boost the entrepreneurial ecosystem in Tunisia by supporting more than forty startups and innovative projects. With a total fund of 28 million dinars, nearly 90% of which is intended to finance startups (up to 500 000 TD), IntilaQ aims to offer a reliable support for Tunisian innovators and entrepreneurs.

Launched in 2016, **Flat6Labs** Tunis is a program for startups that aims at promoting and growth of Tunisian startups. It seeks to provide a source of supply to the Venture Capital industry in Tunisia. In four months, and through its extensive network and its many partnerships, Flat6Labs Tunis will offer Tunisian entrepreneurs financing, a mentoring program, a common workspace, and many other advantages and privileges. In short, a comprehensive entrepreneurial initiation program and numerous preparation workshops, with the aim of finishing startups by external investors to the program.

B@Labs is an initiative launched by BIAT in 2017 that offers an incubation program of 4 to 16 months for innovative startups. This program offers entrepreneurs a work-space, a complete curriculum and specialized workshops, mentoring and individual support, business and administrative services, access to the BIAT network and a potential funding enabling them to explore and realize the full potential of their startups.

Launched in 2016, **Cogite** is a hub for impact-driven, entrepreneurial individuals and organizations that would like to actively contribute to sustainable development in Tunisia. It's a vibrant space for collaboration and knowledge sharing. It is a place with a true sense

of community where exciting projects and initiatives are created. With high speed Internet, meeting rooms, white boards, projection equipment, a large event space, a beautiful garden and even a swimming pool, Cogite provides everything an entrepreneur needs to get work done. It also hosts a wide variety of events, workshops, trainings, and networking opportunities.

Launched in 2017, **Factory 619** is a Startup studio that creates cost-effective and low-risk ventures. It provides state-of-the-art technical support and expertise for start-ups with limited budgets so that they can deploy their products or services on the market. To do so, Factory 619 builds on the expertise of its multidisciplinary team, which was set up over two years following work on joint R&D projects. Developers and experts in Growth Hacking provide an understanding of the market and effective growth strategies that take into account the specificities of the products to be deployed. In addition to the technical and strategic support, this studio offers a wide range of services to large companies to support them in their disruptive approaches to innovation. Moreover, It provides a 700 square meters large co-working space dedicated to freelancers, nomad workers and startups.

In July 2018, the Technopark of Sfax launched a new incubator in partnership with the University of Sfax, UTICA, CONECT, UPMI, CJD, Chamber of Commerce, Djagora Academy as well as the business center. The main objective of this incubator called "**COSTart**" is to boost the creation of start-ups in the field of ICT. COSTart is also a "coworking space" (working space in common) of 700m² of which 300m² will be dedicated to an incubator that will host 30 entrepreneurs per cycle (6 month program). This incubator aims to enable companies to focus their efforts on the technological development of their products, the organization of training programs and marketing support for developed products, the transfer of technologies generated to universities and research centers, the development of businesses, and the creation of jobs and the commercialization of technology.

18. REPUBLIC OF UGANDA

18.1 Introduction

The Republic of Uganda is a landlocked English speaking country in East Africa, bordered by Democratic Republic of the Congo, Kenya, Rwanda, Sudan and Tanzania, and c.800 miles from the Indian Ocean. Uganda has an area of 241,038 km² and 112 administrative districts. The population as at July 2018 was estimated at 40.853 million inhabitants with a literacy rate of 78.4% (CIA World Factbook). 50.2 percent of the population is between 15 and 64 years of age. Uganda's high population growth rates (3.3% per annum) has enabled a 15.1 million strong workforce. Kampala, the capital city, has a population of 2.986 million (2018, CIA World Factbook).

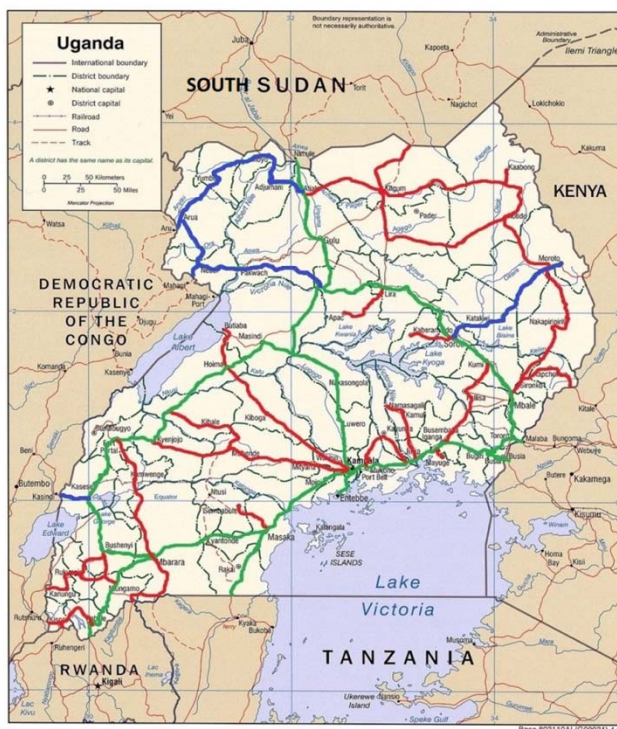


Uganda is a fertile country with regular rainfall and mineral deposits of copper, cobalt and gold. Oil has recently been discovered and the programme for its extraction is underway. Agriculture is the most important sector of the economy, employing over 80% of the work force, followed by services and industry. Uganda's US\$27 billion economy is made up of the agriculture, industry and services sector with services (including ICT) making the highest GDP contribution of 42%, compared to 41% and 17% from the industry and agriculture sectors respectively (ICT sector Investment Profile 2016).

Uganda is striving to meet the Information and Communications Technology (ICT) development objectives laid out in the World Summit on the Information Society (WSIS) Plan of Action as well as in Vision 2040 and the NDP II. According to Uganda Communications Commission in June 2018 there were 252,165 fixed line subscribers and 21.648 million mobile subscribers, with a teledensity of 56.1%. The number of mobile Internet subscribers dropped to 9.855 million while fixed internet subscriptions grew to 173,600 by June 2018. The estimated number of Internet users fell slightly to 18.5 million from the 19.1 estimated in the previous quarter. Internet penetration now stands at 47.4%.

In terms of ICT Infrastructure, there are three Submarine cables supplying Uganda: TEAMS, SEACOM and EASSy. The National Data Transmission Backbone Infrastructure (NBI) and Electronic Government Infrastructure (EGI) are being implemented by NITA-U as a public-private partnership project. Phases I and II of the NBI / EGI resulted in the laying of 1536.39Km of Optical Fibre Cable across the country to build the National Data Transmission Backbone and setting up of the NBI primary data centre and Metropolitan Area Network (MAN). The MAN network consists of the connectivity of 27 ministries and some departments through the laying of optical fibre cable onto

the e-government network. Twenty-two district headquarters across the country were been connected and are benefiting directly from the project.



Key: Coverage of the NBI as by December 2017 Green is completed, blue to be implemented FY 2018/19 Maroon is under funding review.

Figure 1 NBI Roll out (Source NITA-U)

In terms of ICT Infrastructure, there are three Submarine cables supplying Uganda: TEAMS, SEACOM and EASSy. The National Data Transmission Backbone Infrastructure (NBI) and Electronic Government Infrastructure (EGI) are being implemented by NITA-U as a public-private partnership project. Phases I and II of the NBI / EGI resulted in the laying of 1536.39Km of Optical Fibre Cable across the country to build the National Data Transmission Backbone and setting up of the NBI primary data centre and Metropolitan Area Network (MAN). The MAN network consists of the connectivity of 27 ministries and some departments through the laying of optical fibre cable onto the e-government network. Twenty-two district headquarters across the country have been connected and are benefiting directly from the project. Following the NITA-U Act of 2009, the NBI/EGI was handed over to NITA-U in January 2010 to continue and complete the implementation of the respective phases. NITA-U undertook measures to rectify all the implementation challenges that were experienced in Phases I and II. It has now completed the implementation of three Phases of the NBI/EGI Project, and phase IV (extend ICT backbone to West Nile districts and borders points at Oraba with South Sudan, and Vurra and Mpondwe with DR Congo to facilitate regional connectivity and enhance redundancy of the National Backbone).

The Rural Communications Development Fund (RCDF), which was established over 5 years ago, is the Universal Service Fund, which facilitates services to be provided as public private partnerships

in rural areas. UCC subsidises these interventions, which has resulted in the establishment of Internet Points of presence, Internet cafes, multi-purposes community tele-centres, ICT laboratories in schools etc.

There are eight public Universities, 33 Private Universities, 40 public Tertiary Institutions and 51 private Tertiary Institutions in Uganda.

18.2 ICT Background

Uganda's Information and Communication Technology (ICT) sector is one of the most vibrant and fastest growing sectors since its liberalization in 2010, supported by a good ICT legal and regulatory framework. The ICT sector is regarded as a vital pillar for the social economic development of the country as indicated in the National Development Plan (NDP). The integration of ICT into the NDP has increased growth, income and employment through skilled and semi skilled job creation. ICT has contributed towards improvement of government service delivery through eHealth, eEducation, eGovernance, eCommerce and trade. The ICT sector is divided into three areas namely; Policy, Regulatory and Operational with the Ministry of ICT as the lead agency.

Uganda's telecommunications infrastructure is increasing at a 10 percent annual growth rate. MTN, Airtel, Uganda Telecom, Africell, Vodafone, Smile Telecom, Smart Telecom, Sure Telecom and K2 Telecom operate in urban and rural areas in Uganda. 4G networks have been installed around Kampala while 3G networks are available in secondary urban areas around Uganda. According to the 2016–17 Uganda National Household Survey, 68.6 per cent of households owned mobile phones, 61.8 percent in rural and 86.1 per cent in urban areas. All of the operators have deployed mobile-broadband networks, including the latest generation LTE by Smile in 2012, Africell and MTN in 2013, and Vodafone in 2015. The National Data Transmission Backbone Infrastructure (NBI) and the Optical Fibre Cable across the country is well developed, connecting major economic centres.

The Government of Uganda has recognised the critical importance of ICT in national development. It has initiated a policy framework to implement these technologies throughout the country. A number of policy and regulatory reforms have also been undertaken over the past decade to promote development of ICT infrastructure and increase access to affordable communications and IT services. The main policies that support Innovation in Uganda include:

- a) Science, Technology and Innovation Policy (2009) – Implemented through the National Science, Technology and Innovation Plan 2012/2013 – 2017/2018. Expected outputs include a Science and Technology Park and Incubation Centres.
- b) Information Communication Technology Policy (October 2003) reviewed in 2012 and approved in FY 2014/2015
- c) Rural Communications Development Policy implemented by Uganda Communications Commission (UCC) as Rural Communications Development Fund (RCDF) / Universal Service Fund

- d) eGovernment Strategy, formulated in 2004 and approved by Cabinet in June 2011
- e) Telecom Sector Policy (1996) combined with the Uganda Communication Act 1997 (Laws of Uganda Cap 106) resulted in licenses being issued to telecommunications operators, an independent regulator and deregulation of the market
- f) National Broadcasting Policy
- g) Digital Migration Policy

The Government of Uganda has designed the National ICT Initiatives Support Programme (NIISP)⁴⁹³ to facilitate the creation of an ICT Innovation ecosystem and marketplace for Ugandan innovative digital products. NIISP primarily aims at facilitating growth and development of software applications and innovations industry. It will champion the creation of the ICT Innovation ecosystem to facilitate the growth and development of the software applications and innovations industry. It will focus on encouraging the creation of easy to consume and highly marketable digital products.

Uganda has received substantial support from donor agencies in the area of ICT for development. This has translated into a myriad of ICT projects being implemented in various sectors of Ugandan society, most notably in rural infrastructure, education, livelihoods and health. A wide range of Internet points of presence, Internet cafes, training centres, tele-centres, ICT Labs in Schools, Higher Education institutions and Health clinics have been implemented by the Rural Communications Development Fund (RCDF)⁴⁹⁴.

A lot of milestones in terms of policies were achieved during FY 2014/2015 including approval of the National ICT Policy; ICT Strategic and Investment plan developed; Principles of Data Protection and Privacy Bill approved and draft Bill developed; technical support provided to UBC and UCC on analogue to digital migration; Principles for Digital Broadcasting Bill (amendment of Uganda Communications Act 2013) were drafted; first draft of National Broadcasting strategy developed and public awareness campaign on the Regulations for Cyber Laws (Electronic Transaction Act and Electronic Signatures Act) undertaken.

18.3 Current ICT Initiatives and projects

Uganda is currently implementing ICT-related initiatives in the areas of eInfrastructure (Research and Education Network Uganda, Broadband Services ERT Programme, National Backbone, Migration from Analogue to Digital Broadcasting Project, eNetwork project), eGovernment (Electronic Government Infrastructure, Voter Registration, National Identify Cards project, ICT4Democracy in East Africa project), Technology-enhanced Learning (Connect Ed project, National Curriculum Development Centre, VSAT project, SchoolNet Uganda, Content Development at National Teachers Colleges, Connecting Classrooms project, Improving Learning Outcomes

⁴⁹³ <http://niisp.ict.go.ug/>

⁴⁹⁴ <http://www.ucc.co.ug/data/smenu/71/Rural-Communications-Development-Fund---RCDF.html>

through ICT project, ITELE for ICT project, Helping teachers use ICT for Teaching project), eHealth (Improving health care delivery, Health Child project, Electronic Rural Health Information Project, Malaria Diagnostic Systems project), eCommerce (District Business Information Systems, Reflect ICT Resource Centre, Village Phone Project), ICT for Rural Development and Entrepreneurship (Microsoft Innovation Centre). Previous projects included the World Bank Cycle II project to put broadband services in Northern Uganda, ICT4Democracy in East Africa (2011 - 2013, SPIDER),

18.3.1 Research and Education Network Uganda (RENU)

RENU⁴⁹⁵ was set up in 2006 as a not-for-profit limited company owned by the universities and research institutions through the Vice Chancellors Forum to establish a Research and Education Network (NREN) for Uganda. The Uganda Communications Commission granted RENU a special license to operate a private communications network that can provide an international gateway and transmit members' traffic from NRENS in neighbouring countries. In January 2016 RENU was officially recognized as the 75th National Roaming Operator (NRO) in the world for eduroam. eduroam is now deployed in 7 campuses connected to the RENU network.

RENU is a member of UbuntuNet Alliance, part of AfricaConnect, and has an agreement with the Dutch NREN, which facilitates network equipment procurement at discounted prices.

It is currently hosted in Makerere University. By the end of 2016 RENU had connected 63 campuses in Uganda (public and private universities). Each member pays a membership fee. This facilitates group purchasing of bandwidth. The Board of Directors is representative of academia and industry. At present RENU has an ICT Directors Forum and a Librarian meeting. It plans to have a Researchers Forum to facilitate sharing of experiences and an annual research conference to ensure good awareness of the research being undertaken at national level. During 2015 Direct Engineering Assistance agreements were signed with eight universities (Gulu University, Uganda Christian University (Mukono and Mbale campuses) Nkumba University, Makerere University, Multi-Tech Business School, Uganda Management Institute, Ndejje University and Uganda Martyrs University - Nkozi). In a given month, over 60% of all connected campuses now consistently record 100% service availability. RENU now accounts for over 50% of the entire Uganda Internet eXchange Point (UIXP) traffic.

RENU is a beneficiary under AfricaConnect and Africa Connect 2 eInfrastructure projects through UbuntuNet Alliance to a transcontinental network. RENU achieved the unit-price target set as a performance indicator for support received from UCC towards the AfricaConnect project.

18.3.2 eGovernment

The Government of Uganda (GOU) believes that ICT has the potential not only to revolutionize the way Government operates, but also to enhance the relationship between Government and Citizens

⁴⁹⁵ <http://renu.ac.ug/>

(G2C), Government and Business community (G2B) and within Government to Government departments (G2G). With this in mind, the GOU has developed the eGovernment Policy Framework, which clearly identifies the goal of e-Government and its core pillars, critical success factors and a roadmap which will be adopted to achieve it. To operationalize the Policy Framework, Government has developed an eGovernment Masterplan to guide implementation over the next five years. An eGovernment Masterplan has been put in place to guide eGovernment implementation over the next five years. Activities undertaken include:

- NITA-U undertook consolidation of Government hardware and software licenses with the objective of accelerating delivery of e-government services through reduced costs of licenses. A Master Business Services Agreement was signed with Microsoft and negotiations with Oracles are at an advanced stage.
- An Information Access Centre (IAC) was set up at the Ministry of ICT in conjunction with the Government of Korea. The centre aims to enhance citizen participation and engagement in public policy and governance;
- Technical support was provided towards the establishment of a Government Citizen Interaction Centre (GCIC) championed by Office of the President; to Uganda Investment Authority to establish a One Stop Centre (OSC) and to establish over 20 eGOovernment systems including the integration of national systems and databases, Electronic Single Window, eProcurement, eVisa and standardisation of Government websites.

18.3.3.1 National backbone infrastructure and e-government project

The Government of Uganda through the Ministry of Information Communication Technology is spearheading the development of the National Data Transmission Backbone Infrastructure (NBI) and the Electronic Government Infrastructure (EGI). This US\$ 100 million project implemented by NITA-U is a public private partnership designed to complement private sector initiatives to relieve the acute shortage of bandwidth in three phases.

The NBI is intended to ensure that high bandwidth data connection is available in all major towns of Uganda at reasonable rates. The EGI is designed to reduce the cost of doing business in government, improving communication between government agencies and reducing the need for officials to commute for meetings and thus increasing efficiency.

Exim bank approved the loan for Phase III of the National Backbone Infrastructure Project in March 2015. All three phases of the NBI have been completed and include:

- Laying of 1536.39Km of Optical Fibre Cable across the country to build the National Data Transmission Backbone;
- Connection of NBI to the borders of Southern Sudan (Elegu) and Kenya (Malaba and Busia) thereby linking the country to other regional backbone infrastructure;

- Expansion of the Government Metropolitan Area Network into a Wide Area Network covering the towns of Kampala, Entebbe, Bombo, Mukono, Jinja, Busia, Tororo, Malaba, Kumi, Mbale, Soroti, Lira, Gulu, Masindi, Nakasongola, Luwero, Mbarara, Kasese, Fort Portal and Kyenjojo.
- Connected Kabale, Katuna, Malaba, Masaka and Mutukula and put last mile connectivity programme in place to connect other districts
- The National Backbone infrastructure (NBI) was extended to connect 45 sites with Kampala and Entebbe. This has enabled access of high speed internet at affordable costs through bulk procurement.
- Seven Public Universities (Gulu University, Mbarara University, Kyambogo University, Busitema University, Makerere University Business School and Uganda Management Institute) have been connected to the NBI to enable access to high speed internet connectivity and facilitate e-learning and research.
- Five Ministries, Departments and Agencies (URA, MFPED, FIA and MOICT, State House) are now hosted in the NITA-U Data Centre
- Distribution infrastructure for digital TV Broadcasting was installed for the greater Kampala area.
- The Business Process Outsourcing incubation centre was officially launched and employs 323 youth.

The EGI component consists of the e-Government Infrastructure installed in 27 main line Government Ministries, Departments and Agencies (MDAs) and the Primary Data Center. This infrastructure is supporting the Integrated Financial Management System (IFMS), Video Conferencing Services, Voice over Internet Protocol (VoIP) and the Secure Messaging and Collaboration Platform (SMCS). The SMCS platform has been successfully piloted in three sites namely: State House, Ministry of ICT and NITA – U. Other MDAs will follow the roll out of these pilot sites through the IT Rationalisation Program.

Achievements to date include:

1. Delivery and installation of communication equipment to the 27 Ministries and Departments that form the E-Government network has been completed;
2. Videoconferencing services have been deployed to 27 Ministries and Departments;
3. Backup communication equipment for each of the EGI sites have been delivered and installed;
4. VoIP service is currently under test and three (3) pilot sites; NITA-U, Ministry of Foreign Affairs and Ministry of Internal Affairs have been identified for the deployment of the service.
5. NITA-U has realigned the National Backbone Infrastructure Program to confirm quality of the Optic fibre cable and all installations done in Phase I and the subsequent Phases to ensure reliability in providing services to the citizens.

Based on the completion of phase III, NITA-U is offering the following eGovernment services over the NBI infrastructure: Internet bandwidth; Leased Line Services; Hosting/Co-location in National data centre; Unified Messaging and Collaboration System (UMSC); Government Web Portals; Government Citizens Interactions Centre (GCIC); Voice over IP; Connecting to Integrated Financial Management Services and Video Conferencing for MDAs. The end point of the NBI was to ensure all Government services are online. For example:

- UIA One Stop Center, (Uganda Investment Authority)
- EC Voters Register (Electoral Commission)
- E-Visa, E-Tax, E-Single Window (Ministry of Internal Affairs)
- IGG Wealth Declaration (The Inspectorate of Government)

Funding sources: Uganda government and implement by the Uganda Ministry of ICT

Geographic scope and time frame: National; ongoing.

18.3.3.2 Migration from analogue to digital broadcasting project

This project aimed to provide choice to consumers with different service providers through

- Interoperability of systems
- Ensuring the presence of a competitive market
- Efficient use of spectrum

The Digital Broadcasting Migration Policy envisaged the delivery of quality education, health and small, medium and micro enterprises, the opportunity for developing new skills and the creation of new jobs, and new investment opportunities. The key benefit of digital broadcasting is that it enables the utilization of the scarce national radio frequency spectrum far more efficiently than analogue technologies. UCC fulfilled the international switch off of Analogue TV Transmission on 17 June 2015.

Funding sources: Chinese government and implementation by the Uganda Ministry of ICT

Geographic scope and time frame: National; completed.

18.3.3.3 Voter registration- Electoral Commission Uganda project

This project focused on enhancing transparency, accountability in the election management process and increase voter confidence in the electoral process in the 2016 general elections by introducing the Biometric Voter Verification System (BVVS) for verification and authentication at the polling station as the best solution in strengthening the integrity of voter identification during the polling process. This project was supported by the International foundation for Electoral systems and USAID. The purpose was to support the voter registration process and enhance the credibility of the voter registers by strengthening access to the register and providing it online. USAID, the Electoral Commission, and the International Foundation for Electoral Systems (IFES) also cooperated to

develop an SMS text messaging system to facilitate any voter with a cell phone to verify voter registration status and polling station assignments via text

Organization(s)/funding sources: The registry is part of the U.S. government's ongoing support of democracy in Uganda and was funded through a US\$600,000 USAID grant to IFES to work with the Electoral Commission to develop the secure registry site.

Geographic scope and time frame: National

18.3.3.4 National Identity Cards project

The National Security Information System (NSIS) project is focused on implementing a biometric and central data management and identity card registration. It aims to help government to have easy identification of Ugandans on the government pay roll, social security, police and army and within the East African community.

The project is crucial for the creation of a biometric National Identification Register in order to strengthen citizen identity management, national security and for the social economic development of the country. Strategic Objectives include:

- To identify, register and issue national identification numbers to citizen of Uganda.
- To issue National Identity cards to all Citizens of Uganda of 18 years and above.
- To identify and issue cards to foreign residents.
- To issue secure identification cards that enable Ugandans engage in economic and social-political activities.
- To create a platform for integration with other databases of other agencies for ease of data sharing and effective service delivery.
- To enhance people centred growth and development,
- To transform Uganda into a modern Country and to have a more sustained secure and peaceful country.
- Harmonize all efforts related to citizen registration by various Ministries, Departments and Agencies (MDAs), which has now harmonized human, financial, infrastructure and other resources used in the registration.

All eligible Ugandan citizens of voting age (18 years and above) have been registered since 2015 and national identification cards and unique National Identification Number (NIN) are being issued.

The second phase of this strategy is to register citizens aged 0 – 16 Years. Following the closure of the NSIS Project and the enactment of the Registration of Persons Act 2013, National Identification Authority (NIRA) was established to register all Citizens and aliens in Uganda.

In fulfillment of its mandate, the National Identification Authority (NIRA) in collaboration with the Ministry of Education and Sports and other stakeholder institutions (Electoral Commission, Ministry

of Internal Affairs, Ministry of Finance, Planning and Economic Development, Ministry of Local Government, Ministry of ICT, Uganda Police Force, Uganda People's Defense Forces, Directorate of Immigration and Citizenship Control and Internal Security Organization undertook a registration exercise of all school going children in all primary, post-primary and secondary schools/institutions in Uganda from May to August 2017 (School Term II).

Organization(s)/funding sources: Uganda Government, Implementation overseen by Uganda Ministry of ICT

Geographic scope and time frame: National

18.3.4 Technology-enhanced Learning

A number of projects were initiated over the past decade to support the education system including the Connect-ED project to put computers and Internet Points of Presence in Teacher colleges (commenced in 2000 with support from USAID); CurriculumNet Project⁴⁹⁶ to prepare an ICT-based curriculum materials in mathematics and geography for primary schools and mathematics and science for secondary schools (commenced 2001 with support from IDRC); VSAT project and SchoolNet Uganda project; Content Development project at National Teacher Colleges (commenced in 2005 with support from IICD); Connecting Classrooms project (2006 - 2007 supported by British Council); UConnect⁴⁹⁷ supporting connectivity and training in schools (commenced activities in 1995) and iNetwork⁴⁹⁸ Project (commenced in 2002 with support from IICD).

IICD provided support to: the "Improving Learning Outcomes through ICT" project in the Apac District of Uganda (Dec 2011 - Dec 2014); "ITELE for ICT" project in the Serere District in Eastern Uganda (Dec 2011 - Dec 2014) and "Helping teachers use ICT for teaching" project in Western Uganda and West Nile (December 2010 - 01 December 2015).

18.3.5 eHealth

18.3.5.1 *Stre@miline project*⁴⁹⁹

This project focused on the provision of an integrated patient-centred health management informatics system. The project is based in western Uganda. Kisiizi Hospital partnered with Rimpscom Company limited; and IT firm based in Mbarara to develop Stre@miline.

Geographic scope and time frame: regional-based; ongoing.

⁴⁹⁶ <http://www.idrc.ca/EN/Resources/Publications/Pages/ArticleDetails.aspx?PublicationID=716>

⁴⁹⁷ www.uconnect.org/

⁴⁹⁸ www.i-network.or.ug/

⁴⁹⁹ www.streamlinehealth.org

18.3.5.2 Improving health care delivery through continuing medical education for rural health workers

This project is focused on improving health care delivery through continuing medical education (CME) for rural health workers by using ICTs and multimedia. The major focus is on gathering and repackaging high-quality health information for dissemination through ICTs. Training in the use of basic ICTs is provided.

Organisation(s)/funding sources: Co-sponsored by Cordaid and IICD and implemented by Uganda Martyrs University, Faculty of Health Sciences, and the three hospitals of Itojo in Ntungamo district, Nkozi in Mpigi district and Mutolere in Kisoro district

Geographic scope and time frame: District-based; ongoing.

18.3.5.3 ICT Maintenance Facilities for rural technical colleges

ICT maintenance facilities for rural Uganda have been established at five technical colleges. An ICT maintenance facility will be set up at each college to provide technical support and to introduce a new course called ICT Installation and Maintenance to train technicians.

Organisation(s)/funding sources: The Uganda Institute of Information and Communications Technology, established by Uganda Communications Commission, manages the project with the support of the International Institute for Communication and Development (IICD).

Geographic scope and time frame: The five UTCs are located in or near upcountry towns and are geographically well distributed throughout the country. Launched in 2005; ongoing.

18.3.5.4 Health Child / STAR Parent

The STAR Parent project built on past projects implemented by Health Child to improve maternal and child health conditions in Uganda. It ran from October 2012 until 30 September 2015. ICT was adopted to complement the project activities, which focus on improving pregnancy outcomes, neonatal and child survival. The project was implemented in close partnership with Village Health Teams, Local leaders, health centre, District Health Office and Ministry of Health.

Organisation(s)/funding sources: Partners included: Connect4Change, Cordaid, IICD (Netherlands) and Health Child and I-Network (Uganda). Funded through Grant of €166,395 from IICD (€64,725) and Cordaid (€101,670).

Geographic scope and time frame: Jinja, Lira and Apac districts in Uganda, October 2012 to 30 September 2015

18.3.5.5 e-Network

Makerere University College of Computing and Information Technology won an Africa Union (AU) bid to create an e-network that will provide connectivity for Eastern and Central African countries to

a pan-African network through fibre optics and wireless links. This has enabled the sharing of resources such as BlackBoard digital learning software, backups, and elearning courses. The College has a department that trains staff in e-learning and supports elearning in the whole of the university.

Organisation(s)/funding sources: Funding was provided by the Government of India through the AU. Makerere was the lead university serving Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, Sudan, Tanzania, and Uganda.

Geographic scope and time frame: Eastern and central African regions; project announced in July 2006.

18.3.5.6 Electronic Rural Health Information project: Feasibility and Acceptability of e-Card Maternal-Child Health Passport in Rural Community

Towards the end of 2010, the Ministry of Health released a Mother-Child Health Passport (MCH HP). The Mother-Child Health Passport is an initiative to improve maternal and child health in Uganda. It has already been started in a number of African countries including Malawi, Benin, Tanzania and Kenya. It replaces and combines the antenatal and child health cards. This Mother-Child Health Passport is a medical document that records pertinent facts, findings, and observations about an individual child's health history including natal history, past and present illnesses, tests, treatments and outcomes. It has also chronologically documented the care of the mother during pregnancy and the child after delivery, thus offering an important element contributing to high-quality care. As in the rest of Africa, it is paper based and therefore will have the inherent problems associated with manual paper based medical documentation systems. To ameliorate these problems, the paper system is supplemented by an electronic system. This has revolutionised the health care system and efforts need to be made to enable the health system proceed from manual or semi-automatic data processing to a new method of entering, storage, and searching and protecting data using an affordable and safe electronic system.

This has also improved efficiency in data for health care and administration such health insurance accounts and other health surveys.

Organisation(s)/funding sources: Uganda Government in collaboration with ICTs for African Rural Development (ICTARD), Uganda Martyrs University, Nkozi. Department of Computer Science and Information Systems (CSIS)

Geographic scope and time frame: National

18.3.5.7 Malaria Diagnostic Systems project

The overall objective of the malaria diagnostic systems project is to design and implement an easy to use computerized system that has the capabilities to perform accurate diagnosis of malaria, recommend appropriate treatment for malaria, capture and update malaria patient data in real time,

provide a platform for sharing data among health establishments, streamline the reporting to the ministry of health and also generate relevant patients and drug management reports

Organisation(s)/funding sources: Uganda Government

Geographic scope and time frame: National

18.3.6 eAgriculture

The SoCoMoT Project focuses on the development and deployment of a low cost soil conditions monitoring technology that can be deployed up to the level of fields or farms by smallholder farmers through a cloud-based wireless sensor network of internet of Things (IoT) for instrumenting soil condition in order to provide real-time monitoring and data analysis for smart decision-making needed on a day-to-day and season-to-season basis. The SoCoMoT technology provides farmers with valuable information on soil metrics such as soil moisture, nutrients and temperatures that are important for crop health. It supports farmers decisions regarding the best type of crop to plant and when to plant, when to apply fertilizers, when to irrigate and in what amount, among others.

Organisation(s)/funding sources: NARO, Mbarara University of Science and technology funded by Uganda Government under the STI fund from UNCST.

Geographic scope and time frame: central, on going (www.socomot.com)

18.3.6 eCommerce

18.3.6.1 District Business Information Centers

This project aims to address the needs of the community demand driven ICT based services. Since its launch in 2008, the District Business Information Centers (DBIC) project has established DBICS in the Districts of Kamwenge, Lira, Busia, Mityana, Iganga, Rukungiri, Tororo, Kitgum, Rakai, Hoima and Amuru.

Special Training was provided to the initial DBICS Managers to improve their Operations in 2011 and DBICS Managers were trained to provide E-Tax services in their Districts through collaboration with the E-Tax Department in Uganda Revenue Authority. NITA-U has partnered with the United Nations International Development Organization (UNIDO) to further improve the delivery of services in the existing DBICS centres.

Following the ICT Parliamentary Committee Directive to harmonize all DBICs similar projects under UCC, Posta-Uganda and NITA-U, an MOU with Posta-Uganda has been developed to guide onward deployments of DBICS. The Turn Key solution contract was signed in November 2011 with United Engineering Services to deliver DBICS in Amuru, Hoima and Rakai. Installation of the DBICS in Rakai and Hoima was completed by March 2012 after the MOU with Posta-Uganda has been signed. The Installation for Amuru was completed by 24th February 2012.

Organization and funding sources: UNIDO with funding from the Austrian Development Agency (ADA) and in close cooperation with local public and private sector representatives has developed a network of business information centers (BIC) in 8 districts, to see how they can support them in terms of ICT access. These include Arua, Gulu, Jinja, Kabale, Masaka, Masindi, mbale and Soroti

Geographic scope and time frame: 8 districts' initially but extending to another 8 districts in Uganda, 6 to be funded by government (Ministry of ICT) and 2 to be funded by UNIDO. The project is National; ongoing

18.3.7.2 Reflect ICT Resource Centre

The Reflect ICT resource centre has been equipped with computers (Internet connected), printers, digital camera and video, generator, UPS, public address system, World Space radio, and solar-operated radios, along with other office equipment including a photocopier. The aim is to facilitate access to agricultural, health, and commercial information based on needs that the 10 communities identified.

Organization(s)/funding sources: DIFD, and community contributions.

Geographic scope and time frame: The project is located in Bukuuku sub-county in Kabarole district, western Uganda.

18.3.7.3 Village Phone Project

The Village Phone Project⁵⁰⁰ provides micro loans to eight local businesses to enable establishing a community phone service.

Organization(s)/funding sources: Grameen Foundation in partnership with MTN Uganda

Geographic scope and time frame: Started in 2003 in selected communities; ongoing.

18.3.8 ICT for Rural Development

18.3.8.1 Energy for Rural Transformation (ERT) Project

The Second Energy for Rural Transformation (ERT II) Project financed by the World Bank is a long-term project aligned with the Rural Communications Development Fund (RCDF) mandate by extending the country's electricity supply to rural areas. The project has three components: i) construction of the rural energy infrastructure, ii) financing internet broadband extension to rural areas and iii) financing solar PV energy packages for rural schools, health clinics and water facilities.

Organization(s)/funding sources The World Bank funding of US\$75 million. Implementation overseen by Office of Rural Communications Development Fund (RCDF).

⁵⁰⁰ <http://www.grameenfoundation.org/where-we-work/sub-saharan-africa>

The Energy for Rural Transformation (ERT) Project III - Health component is part of the overall ERT Programme under Ministry of Energy and Mineral Development as the Lead Agency with the overall goal of improving delivery of health services in rural health centres through increased access to modern energy and ICT services.

The key areas of intervention will include: Lighting (for both medical buildings & staff houses), Vaccine refrigeration for Health Center II, III & IV, Blood refrigeration at Health Center IV, Energy for operation of essential medical equipment -Microscope, ultrasound scanner, and other low energy consumption equipment in the Health Center IV Theatre using solar power and Energy for Health education, communication and data management

The major objective is to improve the delivery of health services in rural health centers through increased access to modern energy and ICT services. The specific Project objectives include: to increase access to modern energy for lighting for at least 50% of the HCII and HCIII and all HCIV s not connected to the national hydroelectricity grid using solar power and to connect all HCs within 500m of the national hydroelectricity grid.

The ERT Project III will be implemented in the Districts of Alebtong, Buhweju, Buvuma, Hoima, Kaliro, Kamuli, Kapchorwa, Kasese, Kiboga, Kisoro, Kween, Kyankwanzi, Lira, Manafwa, Nakasongola, Namayingo, Otuke, Rubirizi, Busia, Butaleja, Gomba, Lwengo and Namutumba. The District were selected on the basis of the low rural electrification rate and excluded Districts that already benefited from ERT I & II and those are earmarked to benefit from the United Nations Foundation Sustainable Energy for All (SE4ALL) initiatives.

Funding: This is a 4-year project, which started in February 2016 funded by GoU and the World Bank. Implementation of the ERT Project is a shared intervention between Ministry of Health and Ministry of Energy and Mineral Development. The project is estimated to cost UGX 12 BN.

Geographic scope and time frame: National

18.3.8.2 Adaptive Bandwidth Management in Cooperative Wireless Networks: Affordable and equitable access to the Internet

In 2006, the Community Wireless Resource Centre⁵⁰¹ (CWRC), which was established under the Department of Electrical Engineering, Faculty of Technology, Makerere University, setup local wireless networks at three sites – Nabweru Telecentre, Lira Canadian Physicans for Aid and Relief (CPAR) telecentre and Kabale/Kachwekano Telecentres. The wireless networks were established with technical support from IT+46, a Swedish ICT organisation, and with financial support from the International Development Research Centre (IDRC) in the amount of US\$ 89,866. The general objective of the CWRC is to provide or enhance sustainable Internet connectivity infrastructure, particularly in rural or under served areas in Uganda, by means of wireless technology. The specific

⁵⁰¹ <http://cwrc.it46.se/>

objectives were to (1) implement and support the maintenance of community wireless networks, initially targeting the IDRC-funded Telecentres by establishing a Community Wireless Resource Center in the Department of Electrical Engineering, Faculty of Technology, at Makerere University; (2) build capacity, among students at the Electrical Engineering department and the technical staff at the Telecentres, in the design, installation and maintenance of community wireless networks including bandwidth management and efficient traffic provisioning; (3) undertake research to assess the technical feasibility and economic business/partnership models of community wireless networks; and (4) document and share the results widely.

netLabs! Uganda (netLabs!UG) is a research Centre of Excellence (CoE) in telecommunications and networking technologies who had its origins in the Community Wireless Resource Centre (CWRC), Department of Electrical and Computer Engineering, College of Engineering, Design, Art and Technology (CEDAT) at Makerere University. netLabs!UG is an alternative Research and Development (R&D) model which will strive to achieve a balanced critical mass of basic research, applied research and commercialisation.(<http://www.netlabsug.org>)

Organization(s)/funding sources: Uganda Government under the MSI World Bank project

18.3.8.3 NUFFIC ICT⁵⁰² projects

The “Building a Sustainable ICT Training Capacity in the Public Universities in Uganda” NUFFIC One project 2003 – 2008 (€4 million) was very successful in boosting the ICT capacity of staff and students in the four Public Universities in Uganda. The project supported curriculum development and implementation, development of research capacity and advise in the establishment of a Centre of Excellence for ICT Training and Research at Makerere University, ICT infrastructure development, collaborations among the Public Universities, gender policy, ICT Policy and Master Plans leveraging expertise from the Netherlands.

Based on the success of this project, spin off projects were launched including: NPT project on ‘Strengthening ICT Training and Research Capacity in the Four Public Universities in Uganda’; and NPT Project on ‘Strengthening the Institutional Capacity of Uganda’s Technical Colleges. All the project activities and objectives were completed including 5 new MSc and 5 PhD graduates.

In 2008 CIT (Makerere University) together with the Southern Faculty of Computing & Information Technology and IT, the Institute of Computer Science at Mbarara University of Science and Technology, the Departments of Computer Science at Kyambogo and Gulu Universities collaborated to develop, implement and manage relevant educational and research programs for poverty alleviation, rural and economic development. This project (€5.7 million, 2008 - 2011) resulted in Makerere University, Mbarara University of Science and Technology, Gulu University and Kyambogo University partnering with University of Groningen, Radboud University Nijmegen

⁵⁰² <http://sida.mak.ac.ug/?p=919>

(RUN) and Eindhoven University of Technology (TUE) to support University staff and students in the Ugandan institutions and ICT Policy makers.

18.3.9 Other ICT Initiatives

18.3.9.1 Huawei Initiative to address the challenges for local content

As part of an ICT partnership between Makerere University and Huawei to boost ICT in the university, Huawei sent 10 students and tutors for a one week specialized training in ICT at the Huawei Training Center in Nairobi in late June 2012. The programme included WCDMARAN System Overview, LTE Systems Overview and Transport Solution Training, IP Network Technologies and service Training and Mobile SoftSwitch Fundamental Training.

18.3.9.2 Microsoft Innovation Centre

In November 2011 the Innovation Centre (CIT), College of Computing and Information Science, Makerere University was re-launched by United Nations Industrial Development Organization (UNIDO) and Microsoft as the first Microsoft Innovation Centre in Uganda, Initially funded for two years by the Rockefeller Foundation. Hosted at the College of Computing and Information Sciences at Makerere University, the Centre is an extension of the global Microsoft Innovation network and is designed to promote the development of innovation and growth of the Ugandan software economy. The Innovation Centre provides access to PCs, software, desk space and mentoring, and supports both final year students, recent graduates, staff and external entrepreneurs. The facility focuses on skills development and aims to educate local students to help improve their professional IT knowledge and gain real project experience before graduating. In collaboration with the Ugandan Government, National Information Technology Authority Uganda (NITA-U) and Makerere University, the Centre also helps developers and IT professionals learn about the latest technologies, stimulate technology innovation and drive the local software economy to boost national competitiveness. It provides assistance and resources to small and medium sized enterprises to create new and innovative products and services, bring those products to the market and increase their business competitiveness.

18.4 National ICT Research Capacity and Priorities for Cooperation

18.4.1 National Priorities

The Ministry of ICT developed a five year sector Strategic and Investment Plan (ICT SIP) 2015/16 - 2019/20 to guide the systematic deployment of ICT for development and service delivery in line with the Uganda Vision 2040 and the National Development Plan (NDP) 2015/16-2019/20. The Vision of the ICT SIP is “A knowledge-based Uganda enabled by a Vibrant ICT sector” and the mission is “to provide leadership and enabling environment for promotion of ICT as an industry, and enabler for transforming Uganda into a knowledge-based society”. Thematic areas include: ICT Governance; ICT Infrastructure; Human Capital Development and Planning; Information Security; Research,

Innovation and Development; ICT Health, Safety and Environment; Cross cutting areas; Promotion of eServices and Local Content; eGovernment; ICT Industry promotion in target markets and Promotion and Coordination of ICT in other sectors.

National ICT Research Priorities include:

- Health & eHealth: Diagnostics; Epidemiological survey; Health care; Telemedicine; Service delivery. Institutions involved include: Ministry of Health, Makerere University, Mbarara University and Gulu University
- Food Security and Sustainable Agriculture: Climate Change; Agroforestry; Marketing; Agribusiness. Institutions involved include: Ministry of Agriculture, Makerere University, Gulu University and USAID.
- Secure clean and efficient energy. Institutions involved include: Ministry of Education and GIZ.
- Future Internet: Networks, Software Services, Wireless and mobile Applications. Institutions involved include: Makerere University
- Technology-enhanced Learning
- eGovernment
- Digital Content, Digital Libraries and Geographic Information Systems

18.4.2 National Research Capacity

The following universities and research centres in Uganda are undertaking ICT-related initiatives:

- **Makerere University**
 - Departments include: Faculty of ICT⁵⁰³ (Computer Science, Information Technology, Information Sciences), Business School⁵⁰⁴, East African School of Library and Information Science⁵⁰⁵
 - Research areas include: Mobile Applications, ICT for Governance and Policy modelling, eInfrastructures, Information Systems, Networks, ICT for Sustainable Development, Software Engineering
- **Kyambogo University**⁵⁰⁶
 - Departments include: Department of Computer Science; Department of Mathematics; Department of Physics;
 - Research areas include: Technology-enhanced Learning, Inclusive Society

⁵⁰³ <http://cit.mak.ac.ug/>

⁵⁰⁴ <http://www.mubs.ac.ug>

⁵⁰⁵ <http://easlis.mak.ac.ug/>

⁵⁰⁶ <http://www.kyu.ac.ug>

- **Mbarara University of Science & Technology**⁵⁰⁷
 - Departments include: Faculty of Science; Institute of Computer Science
 - Research areas include: Computer Engineering, Computer Science, Computer Services, Information Technology, Software incubation
- **Uganda Christian University (UCU)**⁵⁰⁸
 - Departments include: Faculty of Science & Technology - Departments of Computing, Environmental Science and Health Science
- **Gulu University**⁵⁰⁹
 - Departments include: Computer Science, Library and Information Services, Biosystems Engineering
 - Research areas include: eGovernance, eInclusion, eHealth, Technology-enhanced Learning, Agriculture, Environment
- **Kampala International University**⁵¹⁰
 - Departments include: Computer Science - Information Technology and Systems, Electrical and Computer Engineering, Mathematics, Biological and Environmental Sciences
- **Uganda Martyrs University**⁵¹¹
 - Research areas include: Technology-enhanced Learning
- **Bugema University**
 - Departments include: Computing and Technology
 - Research areas include: eHealth, GIS, Engineering, eEducation; Mobile Communications; eAgriculture

18.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and additional information collected during the IST-Africa Horizon 2020 Training Workshop in December 2016 the following thematic areas are considered to be important in the context of the ICT-39 Call:

⁵⁰⁷ <http://www.must.ac.ug>

⁵⁰⁸ <http://www.ucu.ac.ug/ucunew/>

⁵⁰⁹ <http://www.gu.ac.ug>

⁵¹⁰ <http://www.kiu.ac.ug>

⁵¹¹ <http://www.umu.ac.ug/>

Thematic Areas	Topics	Partners include
eHealth	Health diagnosis and Surveillance; Telemedicine and remote diagnosis; Epidemiology: Disease Surveillance and Early Warning systems; Monitoring of non-communicable diseases (hypertension, diabetes etc)	Makerere University; Mbarara University of Science and Technology; Gulu University
eAgriculture	Commodity Supply Chain, Extension services, Early Warning systems	Mbarara University of Science and Technology; Makerere University; Gulu University
Technology-enhanced Learning	Distance learning, content development	Makerere University; Kyambogo University; Ndejje University; Bugema University; Mbarara University of Science and Technology
Environment	Biomass Energy; Climate change mitigation; Renewable Energy	Makerere University

18.4.4 Mapping to H2020 Themes

The initial mapping to Horizon 2020 Research areas is summarised below

Horizon 2020 Industrial Leadership	Institution, Relevant Dept and Research area
Components and Systems	Makerere University (Department of Electrical Engineering) Uganda Technology Management University: Smart Embedded Components
Advanced Computing	Makerere University Mbarara University of Science and Technology
Future Internet	Makerere University
Content Technologies & Information Management	Makerere University Gulu University: Technology-enhanced Learning Uganda Martyrs University: Technology-enhanced Learning
Robotics	Makerere University (Faculty of Engineering): Robotics

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	Makerere University (School of Public Health): Epidemiology, Diagnostics, Telemedicine Mbarara University of Science and Technology: Epidemiology

	Gulu University (Faculty of Medicine): Diagnostics, infectious diseases, Epidemiology
Food Security, Sustainable Agriculture	Makerere University (College of Agriculture and Environmental Sciences): Sustainable Agriculture, Food Security, Agri-business, Crop breeding, biotech, bioinformatics
Energy	Makerere University (College of Computer and Information Technology, Electrical Engineering and Mechanical Engineering)
Inclusive, Innovative and Reflective Societies	Makerere University (College of Computer and Information Technology): eInclusion
Secure Societies	Makerere University (College of Computer and Information Technology): Information Security

Level of Research Maturity

Uganda has a strong research base and good experience of collaborative research having participated in more than 41 projects and securing over **€ 7.7 million** in research funding under FP7.

Up to September 2018, Ugandan organisations are involved in **23** projects with research funding of **€5.548 million** across a range of thematic areas:

- INFRA, H2020-INFRA-SUPP-2014-2 - **B3Africa** (CSA - Coordination & support action) - Makerere University
- HEALTH, H2020-HCO-2015 - **FRESH AIR** (RIA - Research and Innovation action) - Makerere University
- FOOD, H2020-SFS-2014-1 - **PROIntensAfrica** (CSA - Coordination & support action) - African forum for Agricultural Advisory Services & The Registered Trustees of the Association for Strengthening Agricultural Research in Eastern and Central Africa)
- FOOD, H2020-SFS-2014-2 - **PROTEIN2FOOD** (RIA - Research and Innovation action) - Makerere University
- HEALTH, H2020-HCO-2014 - **SMART2D** (RIA - Research and Innovation action) - Makerere University
- H2020-PHC-2015-single-stage_RTD - **EHVA** (RIA) Uganda National Health Research Organisation
- H2020-WATER-2015-two-stage - **VicInAqua** (RIA) National Agricultural Research Organisation
- H2020-ISSI-2015-1 - **BigPicnic** (CSA) - Tooro Botanical Gardens
- H2020-WATER-2015-two-stage - **WATERSPOUTT** (RIA) - Makerere University

- H2020-ICT-2016-INT - **IST-Africa 2016-2018** (CSA) - Uganda National Council for Science and Technology
- H2020-INFRA-SUPP-2016-1 - **UBORA** (CSA) - Uganda Industrial Research Institute
- H2020-SC1-2016-RTD - **SPICES** (RIA) - Makerere University
- H2020-SC1-2016-RTD - **Perform 2 scale** (RIA) - Makerere University
- H2020-SFS-2016-1 - **LEAP-AGRI** (ERA-NET-Cofund)- Uganda National Council for Science and Technology
- H2020-MSCA-ITN-2014 - **CHIBOW** (MSCA-ITN-ETN) - Facilitation for Peace and Development; All Saints University Lira
- H2020-MSCA-RISE-2015 - **DEMOSTAF** (MSCA-RISE) - Makerere University
- H2020-MSCA-RISE-2015 - **SYBAWHEY** (MSCA-RISE) - Afribanana Products Limited; Kyambogo University
- H2020-ICT-2017-1 (ICT-39-2017)- **EPICA** (IA) - Makerere University; **ISOOKO** (IA) - Makerere University; **WAZIHUB** (IA) - Hive Colab; Women in Technology Uganda
- H2020-SC1-2017-Single-Stage-RTD - **UPSIDES** (RIA) - Butabika National Mental Hospital
- H2020-SC5-2017-OneStageB - **TWIGA** (RIA) - Makerere University
- H2020-SFS-2018-1 - **LEAP4FNSSA** (CSA) - Regional Universities Forum for Capacity Building in Agriculture Limited (forum) by guarantee, The Registered Trustees of the Association for Strengthening agricultural research in Eastern and Central Africa

There is research capacity in the areas of ICT, Environment, Health, Technology-enhanced Learning, Food Security and Agriculture.

Uganda has benefited significantly from participation in the IST-Africa Initiative through capacity building, training workshops, establishing and training of National Contact Points, workshops that support knowledge exchange and collaboration at national level, support for national researchers to publish research papers and present research results at international scientific conferences as well as access to a network of policy makers and research institutions across Africa and Europe.

The IST-Africa Initiative has contributed significantly to the mobilization of the ICT research fraternity in Uganda. Ministry of ICT issued calls for supporting ICT innovation hub in Entebbe.

ICT research funding at national level is currently complicated and insufficient mainly because of its silo-based nature which is at odds with the dynamic, interdisciplinary and cross-fertilization nature of modern ICT related innovations.

18.5 Innovation Spaces

Uganda experienced a rapid growth in Innovation Spaces supporting entrepreneurs from 2010. These included: *Hive CoLabs*⁵¹²; *Microsoft Innovation Centre*⁵¹³ and *iLab@MAK*⁵¹⁴ hosted by

⁵¹² <http://hivecolab.org/>

⁵¹³ www.micuganda.com

⁵¹⁴ <http://cedat.mak.ac.ug/research/ilabs.html>

College of Computing and Information Science, Makerere University; *Outbox*⁵¹⁵ focused on mobile and web entrepreneurs; *Angels Hub*⁵¹⁶ (which took over Mara LaunchPad incubation space in September 2013); the *@TheHub*⁵¹⁷ work space; *FinAfrica*⁵¹⁸ – which has a particular focus on training); Center for Innovations and Professional Skills Development (CiPSD) and RAN Innovation lab at Makerere University; Women in Tech Uganda (WITU) Hub⁵¹⁹; Mawazo Innovation Hub⁵²⁰, TechBuzzHub⁵²¹ and The Innovation Village Kampala⁵²². The Innovation Spaces are focused on providing Pre-Incubation (Hive CoLab, Outbox), Incubation (Angels Hub, Women in Tech Uganda (WITU) Hub, FinAfrica, Innovation Village, TechBuzzHub), Co-working spaces (Hive CoLab, Outbox, The Hub, Mawazo Innovation Hub, Innovation Village, TechBuzzHub), Entrepreneurial Training (FinAfrica) and commercialisation of apps (Grameen Foundation AppLab) (*Cunningham et al 2014*). Other related activities include: the UNICEF supported Uganda Innovation Lab and the UN Global Pulse supported Pulse Lab Kampala⁵²³, which focuses on applications of Big Data; Telesat International⁵²⁴ – a non-profit trade school in Kampala that prepares students for self-employment; CURAD – Consortium for enhancing University Responsiveness to Agribusiness Development⁵²⁵; FabLab Kampala⁵²⁶ and business Innovation services provided by the Uganda Industrial Research Institute⁵²⁷.

Uganda academics and youth dominate the ICT innovation spaces. Over the years a number of exciting products have emerged from these spaces. ICT is therefore one of the key sectors that has the potential to generate jobs and create employment there by contributing to national development.

Some of these are profiled below.

Makerere University is supporting Technology Entrepreneurship through the **Microsoft Innovation Centre (MIC)** established in November 2011 and **Global Business Labs Uganda**⁵²⁸ established in March 2013 (both co-located in the College of Computing and Information Science), and **iLab@MAK**, established in the College of Engineering, Design, Art and Technology in 2005. **MIC** focuses on supporting skills development, fostering innovation and supporting job creation. It provides young entrepreneurs, students, developers and researchers with access to equipment for testing and development of technologies build on the Microsoft platform. **iLab@MAK** provides a low cost, flexible and reliable experimentation platform for digital electronics, communication theory and

⁵¹⁵ www.outbox.co.ug/

⁵¹⁶ <http://angelshub.org/>

⁵¹⁷ <http://thehubkampala.com/>

⁵¹⁸ www.finafrica.org/

⁵¹⁹ <http://witug.org>

⁵²⁰ <http://nftmawazo.com/>

⁵²¹ <http://techbuzzhub.org>

⁵²² <http://innovationvillage.co.ug>

⁵²³ www.unglobalpulse.org/kampala

⁵²⁴ <http://telesatinternational.net/>

⁵²⁵ www.curadincubator.org

⁵²⁶ www.facebook.com/fablabkampala

⁵²⁷ www.uiri.org

⁵²⁸ <http://globalbusinesslabs.com/office/uganda/>

digital signal transmission which can be accessed remotely. They are also collaborating with secondary schools to promote Science and Technology incubation.

Launched in July 2010 and supported by Indigo Trust and Hivos, **iHive Colab** is an innovation and incubation hub that targets university graduate startups and web and mobile technology entrepreneurs. A founding member of **AfriLabs**⁵²⁹, Hive Colab undertakes research, collaborates with local universities and is an implementation partner for InfoDev East Africa Virtual Incubation pilot [14]. The Hub provides co-working space and mentorship for emerging entities and entrepreneurs.

Outbox (member of AfriLabs) was launched in July 2012 as a technology incubator and collaborative working space for mobile and web entrepreneurs, supported by Google and Deloitte. It provides co-working space, mentorship and training programmes.

The founders of **Angels Hub** took over Mara Launchpad Incubator when it closed in September 2013, having been involved in its launch in January 2012. The hub provides residential and commercial work spaces for start-ups and SMEs.

Pulse Lab Kampala was founded in January 2015 as a data innovation centre, under the United Nations Resident Coordinator in Uganda to contribute to the UN "Delivering as One" process. It aims to support interaction between Government, UN, academics and private sector to develop big data analytics technologies to support sustainable development.

The UNICEF **Uganda Innovation Lab** was launched in 2010 to provide work spaces, a physical prototyping workshop, RapidSMS service development hub, video production set and environment to support co-creation. It aims to support technology development as products and mobile services to support information access for end-users and improved data collection methods.

Established in April 2011, **The Hub Kampala** rents collaborative and dedicated working space for freelancers, consultants and entrepreneurs, and collaborates with **FinAfrica** for training.

FinAfrica was founded in 2009 as a not-for-profit training, enterprise incubation and advisory centre. A Cisco Entrepreneur Institute, it can also host up to 20 incubatees.

Grameen Foundation AppLab Uganda develops applications and information services tailored to the needs of the poor. Launched in 2009, the Community Knowledge Worker (CWK) Initiative has over 1,000 ICT-enabled agriculture extension workers trained as data enumerators. Organisations providing services to farmers have access to rural community data. The AppLab Money Accelerator has Gates Foundation funding to expand the mobile money ecosystem and deliver appropriate products and services to the poor.

Women in Technology Uganda was established as a NGO in 2012. It provides a three month Career, leadership and Life Skills training programme for young women in underserved

⁵²⁹ <http://afrilabs.com/labs>



communities focused on STEM, entrepreneurship, leadership and life skills. It runs a Tech Kids Program during school holidays and Secondary Code Girls Program to encourage children and teenagers to engage with STEM.

The **Mawazo Innovation Hub** was established by New Frontier Technologies Consult to support technology commercialization. It is a co-working space that also has ICDL training accreditation.

TechBuzz Hub was established as a social enterprise offering co-working space, incubation, training and web design and hosting services.

The Innovation Village Kampala provides co-working space and a 12-week online accelerator program for start ups. It facilitates community events and demo days. It provides consultancy services and testing opportunities for third parties.

A UK-based not-for-profit, Nesta collaborated with the British Council (East African Cluster) to establish a Global Innovation Policy Accelerator in Kampala, Uganda