Guide to ICT Initiatives and Research Capacity in IST-Africa Partner Countries

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1. EXECUTIVE SUMMARY

1.1 Context and Objectives

The IST-Africa Initiative[1] is actively supporting research cooperation between Africa and Europe. It is currently challenging for both European and African researchers to access up to date information in relation to the current situation in a specific African country that they may wish to collaborate with. There is also a challenge of data fragmentation at national level.

As a result the IST-Africa Consortium have underaken a longitudinal study across the 18 participating African countries in North Africa (Egypt, Tunisia), West Africa (Senegal), East Africa (Burundi, Ethiopia, Kenya, Tanzania, Uganda), Central Africa (Cameroon) and Southern Africa (Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland) since 2009 to provide a comprehensive report that showcases achievements and current status in relation to the ICT research environment.

This study leverages previous knowledge and provides an updated overview of the the current state of ICT and Innovation related policy making, infrastructure, initiatives, national Research prorities and highlights research priorities that are most relevant in the context of the ICT-39 Call of Horizon 2020 (H2020) as well as providing a mapping of research priorities across H2020 thematic areas and national partners. This assists in a better understanding of previous initiatives in key thematic areas that have been supported, the current environment within which applications and pilots needs to be undertaken and showcases national partners with relevant research expertise to faciliate consortia buidling. It also provides the participating Ministries and National Councils with the opportunity to raise awareness among public and private sector research communitiies of what is taking place in other African Member States.

The IST-Africa partner countries made considerable progress in terms of project participation during FP7. It is therefore important to highlight areas for research cooperation under Horizon 2020. It is also important that national ICT research priorities are aligned with national strategic priorities and available expertise. This requires a regular consultation with the national Higher Education Institutions to determine research capacity and identify how public, private and the education and research sectors can collaborate in terms of research and implement solutions leveraging ICT that support socio-economic development at national and regional level.

[1] www.IST-Africa.org/

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The following sections outline the Methodology used, and present a summary of ICT enabling Environment, ICT-related Initiatives and Research Capacity in the targeted countries; National Research Priorities, Priority areas in the context of the ICT-39 Call of H2020 and an initial mapping of research priorities to H2020 themes and a summary of participation under FP7. Each country chapter then provides the full details.

This study is complemented by two other IST-Africa studies entitled "Guide to Living Labs and Innovation Spaces in IST-Africa Partner Countries", November 2014 and “Guide to Bilateral and Multilateral Cooperation Agreements Supporting ICT/STI-related Activities in IST-Africa Partner Countries”, November 2014. All three studies will be updated during 2015.

1.2 Methodology

This study builds on a previous study and body of knowledge collected by IST-Africa Partners during 2009 – 2013.

The initial phase of this study has being undertaken from February to November 2014. The methodology leveraged qualitative data collection and face to face semi-structured 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, desk research and telephone interviews.

IST-Africa partners undertook a consultation with national stakeholders from April to November 2014 in relation to priority areas of most relevance in the context of the ICT-39 Call.

From February to November 2014 the IST-Africa Partners organised Horizon 2020 Workshops in **Egypt** (09 February, hosted by MCIT), **Mauritius** (07 May, hosted by NCB in the context of IST-Africa 2015), **Tunisia** (22 September, hosted by MESRICT), **Malawi** (12 November, hosted by NCST), **Kenya** (14 November, hosted by MoEST), **Ethiopia** (17 November, hosted by MCIT), **Uganda** (20 November, hosted by UNCST) and **Burundi** (24 November, hosted by MESRS). Additional information was collected during these workshops.

1.3 ICT Enabling Environment and ICT Initiatives

North, Central and West Africa

Egypt has a vibrant research community and strong experience in collaborative research with 29 public Universities, 33 private Universities and more than 400 private Higher Education Institutions. The Egyptian Government has significantly invested in capacity building, digital literacy and certification of skills, with over 126 IT Houses and 2,163 IT Clubs in operation around the country. The ICT Policy (2013 – 2017) is focused on achieving sustainable socio-economic development with key ICT sectors identified to 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. There is good eInfrastructure with links to three submarine cables, a national backbone

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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.

Tunisia has a strong research base with 13 public Universities including a virtual university, 15 public Higher Education Institutions and more than 44 private HIgher Education Institutions. 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. ICT Initiatives are focused on eGovernment Services, eInfrastucture for Education and Research, eInfastructure for Innovation (such as Technology and Cyber Parks) and support measure for software companies and start-ups.

Cameroon has a good research base and experience in collaborative research with 8 public Universities, over 80 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) and the National ICT and Telecoomuniction Strategy is currently being revised. eInfrastructure is gradually improving with a national backbone of over 6,000 km of fibre optic cable, a fibre optic loop in Douala with a second being laid in Yaounde (Capital) and the ongoing establishment of a National Internet eXchange point (IXP). There are 60 operational tele-centres, with a further 110 being put into service and 15 under construction. ICT Initiatives are pimarily focused on eGovernment Services (including Legal and Regulatory Framework), National PKI, ICT Programmes in Primary and Secondary Schools, National Identity Card Computerisation and Biometric Passports.

Senegal has a good research base with six public Universities (3 more being created), 7 private Universities, 5 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. The Science Technology and Innovation Policy is under development. 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 SnREN (Nationa Research and Education Network) is supporting HEIs. ICT Initiatives are focused on eGovernment, Digital Divide, Research, eInfastructures, Entrepreneurship and eEducation.

East Africa

Burundi is slowly building up the institutions and infrastructure following twelve years of crisis up to 2005. There are 7 public universities and 24 private institutions of Higher Education. The National ICT Policy was revised and adopted in 2011, the National Policy for Science, Technology and Innovation (STI) adopted in 2011 with an implementation framework for 2014 - 2018 and the decree to establish the National Commission for Science, Technology and Innovation was signed in July 2014. A fibre-optic project is currently running to provide ICT infrastructure across the country alongside development of the National Backbone. The Burundi Education and Research Network (BERNET) has been established and the ICT Executive Secretariat has enabled the physical Last

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Mile connection to the 15 core members of BERNET. ICT initiatives are currently focused on eInfrastructure and eGovernment.

Ethiopia has a good research base and experience in collaborative research with 31 public Universities and 42 private Higher Edudation Institutions. There is a good Policy Framework in place with the ICT Policy and Strategy (2009), National Science, Technology and Innovation (STI) Policy (2012) and ICTs in Education Implementation Strategy and Action Plan (2010). eInfrastructure is rapidly improving with 12,000 kms of optic fibre cable radiating from central Ethiopia across the country and connecting all cities, with the capacity to transmit 40 Gbps along with the national backbone. MCIT has established 200 Community Information Centres and 11 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.

Kenya has a vibrant research community and strong experience in collaborative research with 22 fully chartered Public Universities, 9 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. There is a good Policy Framework in place including Kenya ICT Policy 2006 (under review), eGovernment Strategy, Kenya ICT National Master Plan 2017, Kenya Science, Technology and Innovation (STI) Policy 2012 and Vision 2030. There is good eInfrastructure with a national fibre optic infrastructure and links to four submarine cables. KENET is the 2nd largest NREN in Africa supporting 115 campuses and managing the largest IP network in Kenya. ICT Initiatives are focused on eEducation & eSkills, Digital Inclusion, Business Process Outsourcing, Local Content, Information Security and eGovernment.

Tanzania has good research capacity with 11 Public Universities, 17 private universities and 26 private institutions of Higher Education. Two of the three main policies supporting Innovation and Entrepreneurship are under revision: the updated Science Technology and Innovation (STI) Policy will incorporate Entrepreneurship and the National ICT Policy of 2003 is under review as part of the development of a new implementation strategy. 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). The Tanzania Education Research Network (TERNET) has connected 14 Institutions (min 10Mbps) to the Network Operations Centre (NoC) at COSTECH. ICT Initiatives are primarily focused on eInfrastructure, eEducation, eHealth, Information Society & Entrepreneurship.

Uganda has a strong research base and good experience in collaborative research with 6 Public Universities, 29 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 2003 (under review), Rural Communications Development Policy and eGovernment Strategy (2011).

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eInfrastructure is rapidly improving with a national backbone of over 5,000 km of fibre optic cable, National Data Transmission Backbone Infrastructure (NBI) and Electronic Government Infrastructure (EGI) being finalised and links to three submarine cables. ICT Initiatives are primarily focused on eInfrastructure, eGovernment, Technology-enhanced Learning, eHealth, eCommerce and ICT for Rural Development and Entrerpreneurship.

Southern Africa

Angola has 22 Public Universities, 40 private Higher Education Institutions and three research institutions focused on Agriculture, Fisheries, Veterinary and Health. The Policy Framework includes a White Paper on ICT (2006), National Policy on Science, Technology and Innovation (2011), National Strategy on STI (2011) and a Strategy on Development of Information Technology (2000 - 2010). In terms of eInfrastructure, there is a national backbone based on fibre optic and submarine cables, an IXP, 500 telecentres and links to five submarine cables. ICT Initiatives are primarily focused on eGovernment, Digital Divide and Technology-enhanced Learning.

Botswana has 2 public Universities, 2 private institutions of Higher Education as well as eight public Higher Education Institutes including DVET. There is a good Policy Framework including the Maitlamo National Policy for ICT Development (2007) and the revised Research, Science, Technology and Innovation Policy (2012). There is relatively good eInfrastructure with fibre-optic networks and a National Backbone. ICT Inititatives primarily focus on Digital Divide, eGovernment, Innovation and Entrepreneurship.

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) and National Strategic Development Plan (2013 – 2017). The mountaineous terrain presents challenges for eInfrastructure which is improving gradually with a national backbone (mix of copper cables, fibre optic cables and satellite), links to two submarine cables, IXP being established and the completion of 17 GSM network infrastructure projects with subsidies from the Universal Access Fund. ICT Initiatives are primarily focused on eLearning, eHealth, eGovernment, Cyber Security and eInfrastructure.

Malawi has a good research base and experience in collaborative research with 3 Public Universities (University of Malawi, Mzuzu University and Malawi Unviersity of Science and Technology), 7 public Polytechnics and specialised Colleges and 4 private Colleges. There is a good Policy Framework including the revised ICT Policy (2005) to include Universal Access (2013), National ICT Master Plan for 2014 – 2031 (under development), Vision 2030 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. ICT Initiatives are primarily focused on eGovernment, eInfrastructures, eHealth, Technology-enhanced Learning and Digital Repositories.

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Mauritius has a good research base with 5 Public Universities (UoM, UTM, UDM, MIE, Open University) and 3 private Universities (Charles Telfair, Middlesex, EIILM). There is a good Policy Framework including the National ICT Strategic Plan (NICTSP), National Broadband Policy 2012 - 2020, eGovernment Strategy 2013 - 2017 and National Cyber Security Strategy and Action Plan (2014 - 2019). eInfrastructure is well developed across the island with a IXP, National PKI, links to three submarine cables, 264 computer clubs with free internet access and 100 public internet access points in Post Offices. ICT Initiatives are primarily focused on eEducation, Digital Divide, eGovernment, Cyber Security, Entrepreneurship and Green IT.

Mozambique has research capacity and a track record in collaborative research with 2 Public Universities, 8 public Higher Education Institutions, 10 private Universities and 22 private Higher Education Institutions. Twenty-two institutions are dedicated to research activities, 15 of which are government institutions and 7 private. There is a good Policy Framework including the ICT Policy (2000) and ICT Policy Implementation Strategy (2002). 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. ICT Initiatives are primarily focused on eGovernment, eHealth, eInfrastructure, Digital Content and Digital Divide.

Namibia is gradually increasing the focus on research with 2 Public Higher Education Institutions (University of Namibia, Polytechnic of Namibia) and one private University. There is a good Policy Framework in place including Vision 2030; National Development Plan 4, NRSTIP, ICT Policy (1995), eGovernment Policy (2005) and ICT in Education Policy (2005). eInfrastructure is improving with fibre optic cables connections to all major towns, investment in a nationalwide terrestrial fibre backbone infrastructure, IXP, Xnet (NREN) and links to two submarine cables. ICT Initiatives include eEducation, eHealth and eGovernment.

South Africa has a vibrant, well developed research community and a good track record in collaborative research with 25 state-funded tertiary institutions (Universities & Universities of Technology) and 87 private institutions of Higher Education. There is a good Policy Framework including the ICT Policy (under review), Broadband Policy (2013), ICT RDI Implementation Roadmap (2013) and CyberSecurity Policy. eInfrastructure for research is well developed with TENET (Tertiary Education and Research Network of South Africa) 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. TENET provides Internet and related services to around 170 campuses of 55 institutions. ICT Initiatives focus on eInfrastructure, Digital Access, eSkills, Smartcard IDs and TV White Spaces Trials.

Swaziland is gradually increasing the focus on research with one public university and three private Higher Education institutions. There is a good policy infrastructure focused on the adoption of ICT to support socio-economic development (ICT Policy 2004, National Information and Communication

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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 Initaitives are primarily focused on eGovernemnt and development of the Science and Technology Park with funding from Taiwan.

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

1.4 National Research Priorities and Initial Mapping to Horizon 2020

In an African context ICT must be seen as a horizontal enabler in all areas of Service delivery - eHealth, eGovernment, eAgriculture, eEnvironment, eEducation and eInfrastructures. This requires a multidisciplinary approach including thematic experts, computer scientists and user interface experts for example. The ability to deliver 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
- Cloud Computing including Parallel and High Performance Computing, Simulation Software
- Technology-enhanced Learning including eSkills, Blended Learning, frameworks to support development of content objects, personalised learning
- 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

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

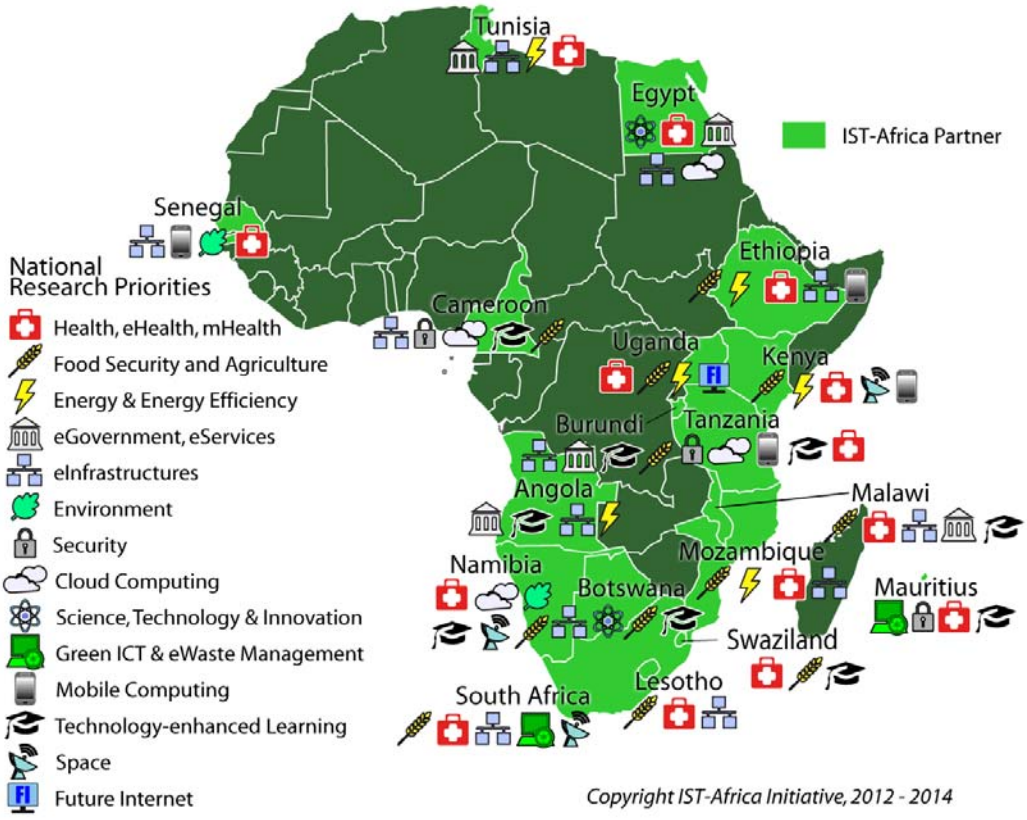

Diagram 1: Overview of National Research Priorities

Table 1: National Research Priorities in IST-Africa Partner Countries

IST-Africa Partner Country	National Research Priorities include:
Angola	eInfrastructures, Technology-enhanced Learning, Solar Energy, Informatics & Electronics, Digital Inclusion
Botswana	eInfrastructures, Technology-enhanced Learning, Sustainable Agriculture, Entrepreneurship
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 and Sustainable Agriculture
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	Telecommunications, Electronics and Computers (TEC); Science, Technology, Engineering and Mathematics Education;

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	Coordination of Technology, Innovation and Commercialisation; Space Science and Energy
Lesotho	eInfrastructures, eGovernment, eHealth, Technology-enhanced Learning, eAgriculture
Malawi	eHealth, eAgriculture, eInfrastructure and 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
Mozambique	eHealth, Food Security and Agriculture, Future Internet, Technology-enhanced Learning, eGovernment, ICT for Rural Development and Entrepreneurship.
Namibia	Digital Content, Technology-enhanced Learning, eGovernment, eHealth, eAgriculture & Fisheries including Water; Entrepreneurship, Mining & Geosciences, Biotechnology, Logistics and Space Science.
Senegal	eGovernment, eInfrastructures, Entrepreneurship, Digital Divide, eHealth, Technology-enhanced Learning,
South Africa	Future Wireless Technologies, eInclusion, eAgriculture, Green ICT, Geo-spatial Applications, Astronomy, Bio-Medical Services, eHealth, Technology-enhanced Learning, Content Localisation, Trust and Security
Swaziland	eHealth, eAgriculture & Food Security, eInfrastructures, Environment, Entrpreneurship
Tanzania	eInfrastructures, Cloud Computing/ High Performance Computing, Cyber Security, Mobile Computing, ICT for Creativity and Learning, eHealth, eAgriculture
Tunisia	eHealth, eInfrastructures, Services and Trusted Networks, eServices and Knowledge Economy and ICT for Energy Efficiency
Uganda	eHealth, Food Security and Sustainable Agriculture, Energy, Envionment, Future Internet, eGovernment, Digital Content, Technology-enhanced Learning

Table 2 below provides an overview of the Thematic areas of highest priority in the context of the ICT-39 H2020 Call. 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 2: Thematic areas of highest priority to ICT-39

IST-Africa Partner Country	**Thematic areas of highest priority to ICT-39**
Angola	eHealth; eAgriculture; Environment
Botswana	eHealth, eAgriculture, Technology-enhanced Learning
Burundi	eHealth; eAgriculture; Energy

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Cameroon	eHealth; eAgriculture; Environment; Technology-enhanced Learning
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; Technology-enhanced Learning; Environment; eGovernment;
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
Namibia	eAgriculture; eHealth; Technology-enhanced Learning; eGovernment;
Senegal	eHealth; Environment
South Africa	eAgriculture; eHealth; Technology-enhanced Learning; Environment; eGovernment; Digital Inclusion
Swaziland	eAgriculture; eHealth; eGovernment; Environment
Tanzania	eAgriculture; eHealth
Tunisia	eAgriculture; eHealth; Environment; eGovernment; Technology-enhanced Learning
Uganda	eAgriculture; eHealth; Technology-enhanced Learning; Environment

Diagram 3 and 4 below provide visual representation of priority themes in the context of the ICT-39 H2020 Call and an overview of some of the national partners who have research expertise in the selected themes for ICT-39.

Tables 3 & 4 below provide an overview 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.

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Diagram 3 Priority themes in IST-Africa partner countries in context of ICT-39 H2020 Call

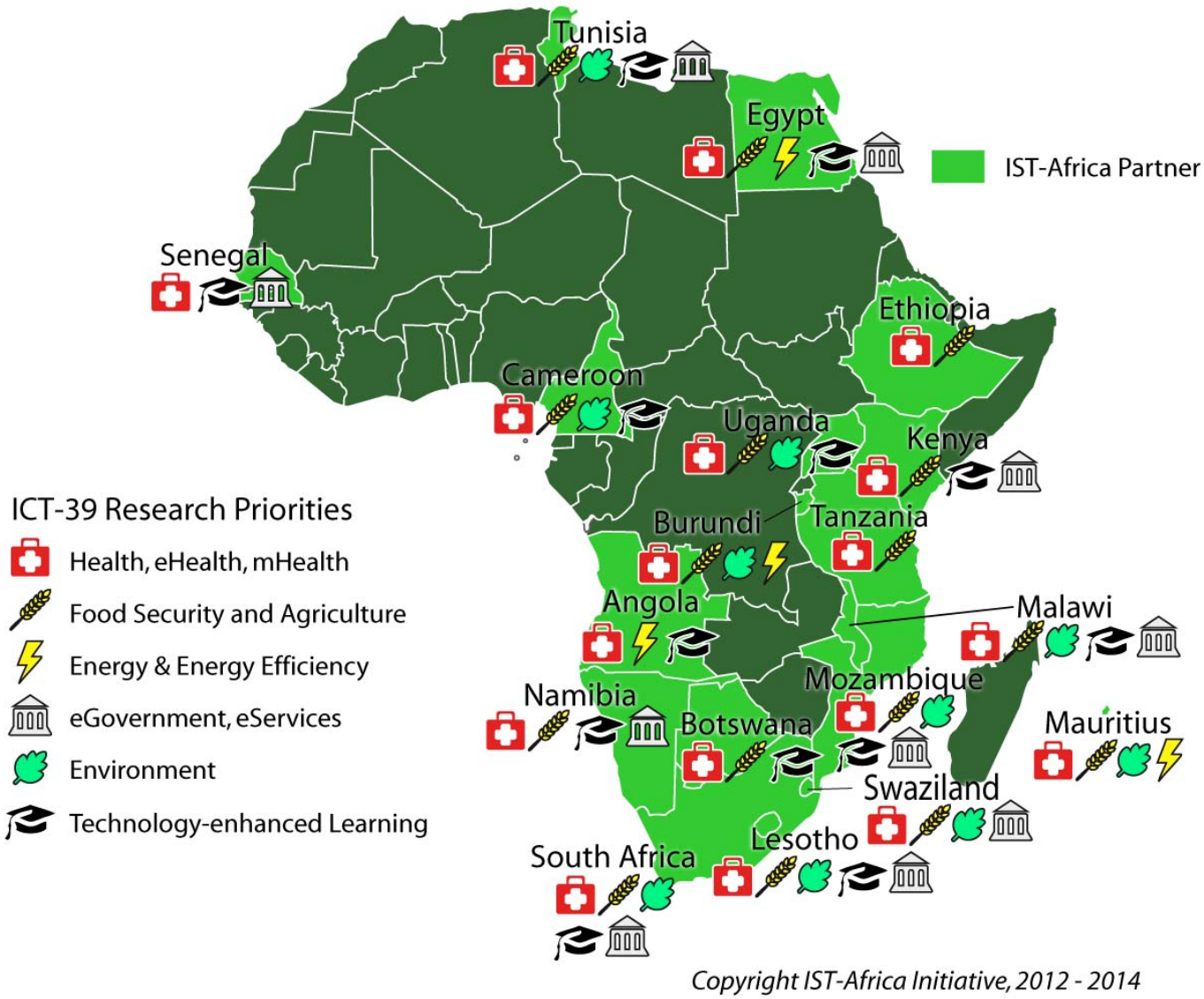

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Diagram 4 Oveview of some of the Institutions in IST-Africa partners countries in relation to ICT-39 themes

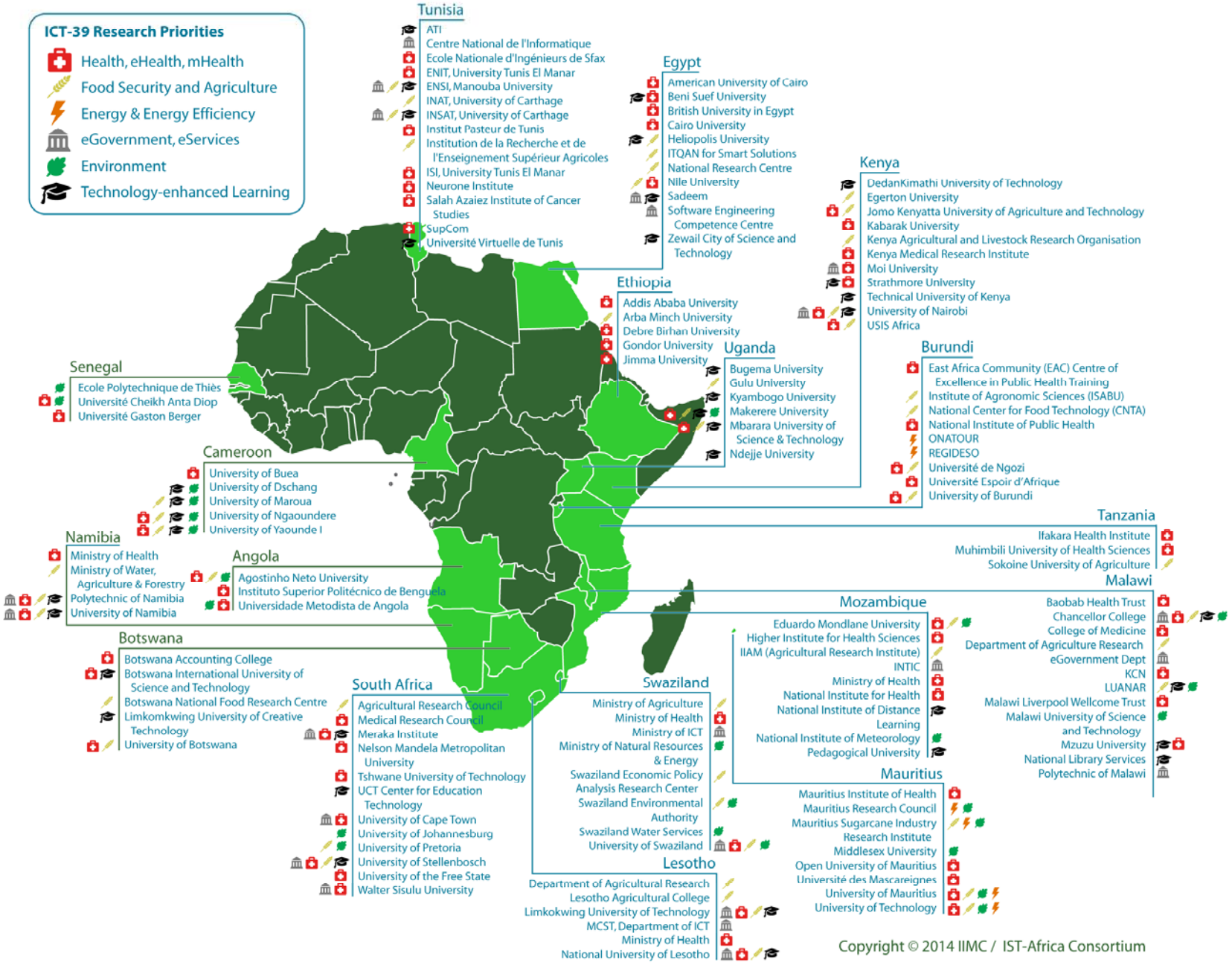

Table 3: Mapping of Research Expertise in relation to LEIT areas under Horizon 2020 in IST-Africa Partner Countries

Country	LEIT Areas of Most Relevance	Institutions include
Angola	Components & Systems, Advanced Computing, Content Technologies & Information Management	Instituto Superior Politécnico de Benguela (Engineering Department) Universidade Agostinho Neto Universidade Mandume Yandemufayo
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.) 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 Douala (Dept of Maths and Informatics) University of Dschang (Dept of Maths and Computer Science) University of Maroua (ISS) University of Ngaoundere (Dept of Maths and Computer Science) University of Yaounde I (ENSP)
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

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		Communications, College of Computing and Information Technology) Azhar University (Dept of Computer Engineering) National Telecommunication Institute (Depts. of Networks, Electronics) Egyptian National Scientific and Technical Information Network(ENSTINET) Information Technology Institute
Ethiopia	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management	Addis Ababa University (Institute of Technology, IT Doctoral Programme, School of Info Sciences) Gonder University (Dept of Computer Science, School of Technology) Haramaya University (Depts of Computer Science, Information Systems, Information Science, Information Technology, Software Engineering) Mekelle University (Ethiopian Institute of Technology) Arba Minch University HiLCoE School of Computer Science and Technology College ICT Centre of Excellence Jimma University
Kenya	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management	University of Nairobi (Schools of Computing and Informatics, Engineering, FabLab) KCA University (Faculty of Computing and Information Management) Jomo Kenyatta University of Agriculture and Technology(JKUAT) (Depts of Computing, IT, Telecoms) Strathmore University (Faculty of Information Technology, @iLabAfrica) Moi University (Schools of Engineering, Information Technology) Egerton University (Faculty of Engineering & Technology) Kenyatta University (School of Engineering & Technology) Kenya Education and Research Network (KENET) United States International University
Lesotho	Advanced Computing, Future Internet, Content Technologies & Information Management	National University of Lesotho (Dept of Maths and Computer Science) Limkokwing University of Creative Technology (Dept of Computer Techhnology) Lesotho College of Education
Malawi	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management	Chancellor College, University of Malawi (Dept of Computer Science, Department of Physics) Polytechnic 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) Kamusu College of Nursing (Community and Mental Health Dept)

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Country	LEIT Areas of Most Relevance	Institutions include
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	Instituto Nacional de Tecnologias de Informacao e Comunicacao 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
Namibia	Future Internet, Content Technologies & Information Management, Robotics	Polytechnic of Namibia (School of Information Technology) University of Namibia (Depts of Computer Science, Electronics and Telecommunication Engineering, Multidisciplinary Research Centre)
Senegal	Components & Systems, Future Internet, Content Technologies & Information Management, Robotics	Université Cheikh Anta de Dakar Université Gaston Berger Ecole Polytechnique de Thiès Université Alioune DIOP de Bambey Université Assane Seck de Ziguinchor Ecole Superieure Polytechnique de Dakar-UCAD
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 Western Cape

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		CSIR Meraka University of Zululand (Depts of Computer Science and Information Systems) University of South Africa (UNISA) (Dept of Electrical Engineering, Centre for Software Engineering, School of Computing) University of Free State (Dept of Computer Science & Informatics) Durban University of Technology (Depts of Electronic Engineering, Accounting & 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) Stellenbosch University (Depts of Electrical and Electronics Engineering; Computer Science; Centre for Languages and Speech Technology) Central University of Technology (Depts of Electrical, Electronic and Computer Engineering, Information 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) Mangosuthu University of Technology
Tanzania	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management, Robotics	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) 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 &

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		Management; Communication Science & Engineering) Ardhi University (Centre for ICT)
Tunisia	Components & Systems, Advanced Computing, Future Internet, Content Technologies & Information Management, Robotics	University of Tunis (Higher School of Sciences and Techniques of Tunis) University of Cathage (Higher School of Communications Technology (SupCom); National Institute of Applied Sciences and Technology (INSAT); Higher School of Technology & Computer Science of Carthage (ESTI) University of Manouba (National School of Computer Sciences (ENSI) University of Sfax (National School of Engineers of Sfax (ENIS) National Institute of Applied Sciences and Technology (INSAT) University of Tunis El Manar (National School of Engineers of Tunis (ENIT) Centre National de L'informatique Centre D'etudes et de Recherches de Telecommunications
Uganda	Computing, Future Internet, Content Technologies & Information Management, Robotics	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) Gulu University

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Table 4: Initial 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
Angola	Health, Food Security and Agriculure, Climate Action / Environment	***Health*** - Instituto Superior Politécnico de Benguela (Engineering Department); Universidade Agostinho Neto ***Agriculture*** - Universidade Agostinho Neto; Univesity Kimpa Via (HIgher Polytechnic School) ***Climate Action / Environment*** - Universidade Agostinho Neto; Universidade Independente de Angola, Universidade Metodista de Angola
Botswana	Health; Food Security and Agriculture, Energy, Transport, Secure Societies	***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) ***Agriculture*** - Botswana National Veterinary Laboratory, Botswana National Food Research Centre ***Energy*** - Botswana International University of Science and Technology (MEGE Dept) ***Transport*** - Botswana International University of Science and Technology (MEGE Dept) ***Secure Societies*** - Botswana International University of Science and Technology (Applied Sciences); Botho University (Faculty of Computing)
Burundi	Health; Food Security and Agriculture, Energy	***Health*** - University of Burundi (Faculty of Medicine, Faculty of Science); National Institute of Public Health (INSP); Université de Ngozi (Health Science Institute/Faculty), Université Espoir d'Afrique (Faculty of Medicine) ***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 ***Energy*** – REGIDESO, ONATOUR, University of Burundi
Cameroon	Health; Food Security and Agriculture; Energy; Transport; Environment; Innovative Societies; Secure Societies	***Health*** – University of Dschang (Dept Maths & Computer Science); University of Maroua (Computer/Telecom); University of Ngaoundere (Math/CS); University of Doula (Math/CS) ***Food Security & Agriculture*** - University of Maroua (Computer/Telecom); University of Ngaoundere (Math/CS) ***Energy*** – University of Dschang (Dept Maths & Computer Science); University of Maroua (Computer/Telecom); ***Transport*** - University of Maroua (Computer/Telecom) ***Climate Change & Environment*** - University of Ngaoundere (Math/CS) ***Inclusive, Innovative & Reflective Societies*** - University of Maroua (Computer/Telecom) ***Secure Societies*** - University of Maroua (Computer/Telecom); University of Ngaoundere (Math/CS)

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Country	Societal Challenges of Most Relevance	Institutions include
Egypt	Health; Food Security and Agriculture; Energy; Transport; Environment; Innovative Societies; Secure Societies	***Health*** - American University of Cairo; Nile University (Center for Informatics Science, Centre for Nanotechnololgy); 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) ***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 ***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, Heliopolis University ***Enviroment*** – Nile University (Nano Electronics Integrated Systems Centre, Center for Nanotechnology); Cairo University; Egyptian Environmental Affairs Agency; Ministry of Water Resources and Irrigation, Heliopolis University ***Transport*** - Ain Shams University; National Telecommunication Institute ***Inclusive, Innovation and Reflective Societies*** – Nile University; Heliopolis University, Bibliotec of Alexandria (CULTNAT) ***Secure Societies*** – American University of Cairo, Nile University (Centre for Informatics Science)
Ethiopia	Health; Food Security and Agriculture; Energy; Environment; Secure Societies	***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 ***Food Security & Agriculture*** - Mekelle University, University of Gondor, Arba Minch University (Department of Computer Science) ***Energy*** – University of Gondor ***Environment*** - Geological Survey of Ethiopia; Geosas Consulting Service Plc; Arbaminch University; Addis Ababa University; Mekelle University; University of Gondor; HiLCOE ***Secure Societies*** – Haramaya University; HiLCoE
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) ***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)

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		Efficient Energy - Strathmore University (@iLabAfrica), JKUAT, University of Nairobi ***Transport*** - Strathmore University (@iLabAfrica), JKUAT, University of Nairobi ***Digital Inclusion, eGovernment, eLearning*** - Strathmore University (@iLabAfrica)
Lesotho	Health; Agriculture; Energy	***Health*** - National Health Training Centre; University of Lesotho (Dept of Pharmacy and Nutrition); Limkokwing University of Creative Technology ***Agriculture*** – University of Lesotho (Faculty of Agriculture) ***Energy*** – 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 of Malawi ***Agriculture*** – LUANAR, Mzuzu University; Lilongwe University of Agriculture & Natural Resources, Dept of Agricultural Research Services ***Environment*** - Lilongwe University of Agriculture & Natural Resources ***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 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 Research Council, Mauritius Sugarcane Industry Research Institute ***Environment, Climate Change*** - University of Mauritius (Dept of Chemical & Environmental Engineering), University of Technology Mauritius, Université des Mascareignes ***Energy, Green ICT, Smart Cities*** – Charles Telfair Institute, University of Mauritius (Dept of Chemical & Environmental Engineering; Dept of Mechanical and Producation Engineering), Mauritius Research Council, University of Technology Mauritius (School of Sustainable Development and Tourism), Mauritius Sugarcane Industry Research ***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 ***Secure Societies*** - Université des Mascareignes, University of Technology Mauritius, Open University of Mauritius

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Country	Societal Challenges of Most Relevance	Institutions include
Mozambique	Health; Food Security and Agriculture; Environment	***Health*** - Eduardo Mondlane University UEM (Faculty of Medicine), Higher Institute for Health Science ***Agriculture*** - Agrarian Research Institute of Mozambique (IIAM), CIDE, Pedagogical University ***Environment*** - Instituto Nacional de Meteorologia; UEM; IIA (Water Research Institute); University of Zambeze
Namibia	Health; Food Security and Agriculture; Energy; Environment; Inclusive and Reflective Societies	Polytechnic of Namibia (School of Health and Applied Sciences, School of Natural Resources and Tourism, School of Engineering, Renewable Energy and Energy Efficiency Institute) University of Namibia (Faculty of Health Sciences, Faculty of Agriculgture and Natural Resources,
Senegal	Health; Environment; Cultural Resources; Secure Societies	***Health*** - Université Gaston Berger; Université Cheikh Anta Diop ***Environment*** - Université Cheikh Anta Diop; Ecole Polytechnique de Thiès; Ecole Superieure Polytechnique de Dakar - UCAD ***Cultural Resources*** - Ecole Polytechnique de Thiès ***Secure Societies*** - Ecole Polytechnique de Thiès
South Africa	Health, Energy, Innovative Societies, Secure Societies	***Health*** - Walter Sisulu University; University of KwaZulu-Natal; University of Witwatersrand; University of Pretoria (School of Health Systems and Public Health); CSIR Meraka; Mangosuthu University of Technology; Vaal University of Technology, Medical Research Council; University of Free State; University of Stellenbosch (Faculty of Health and Medicine); Rhodes University (Natural Products and Medicinal Chemistry Research Group); University of Cape Town (Drug Discovery and Development Center), Nelson Mandela Metropolitan University ***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 ***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 Electircal and Electronics); Univerisity 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 Metropolitan University ***Innovative Societies*** - Rhodes University; Fort Hare University; University of Stellenbosch; CSIR Meraka; University of South Africa; Tshwane University of Technology; North West University; Nelson Mandela Metropolitan University

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		Secure Societies - CSIR MDS; University of KwaZulu-Natal; University of Limpopo; Tshwane University of Technology; University of Stellenbosch
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	***Health*** - Ifakara Health Institute; Muhimbili University of Health and Allied Sciences; Catholic University of Health and Allied Sciences; Kilimanjaro Christian Medical University College, Tumaini University ***Agriculture*** - Sokoine University of Agriculture; Open University ***Energy*** - Ardhi University ***Transport*** - Ardhi University; National Institute of Transport ***Environment*** – Open University ***Inclusive, Innovative and Reflective Societies*** – University of Bagamoyo ***Secure Societies*** - University of Dodoma; Institute of Financial Management; Dar es Salaam Institute of Technology
Tunisia	Health; Food Security and Agriculture; Energy; Environment; Transport; Innovative Societies; Secure Societies	***Health*** - ENIS; SupCom; ENSIT; Centre D'etudes et Recherches Prospectives; Institut Pasteur de Tunis; Institut National de La Sante Publique, ***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; ***Energy*** - ENIS; SupCom; ENSI; ENSIT; Alternative Energy Systems SARL; Ecole Nationale d'Ingenieurs de Tunis ***Environment*** - 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 Recherches et des Technologies des Eaux; Université de Tunis; Sfax University; Institut des Regions Arides ***Transport*** - ENSI; ENIS; ENSIT ***Innovative Societies*** - ENSI; ENIS; ENSIT
Uganda	Health; Food Security and Agriculture; Energy; Transport; Environment; eInclusion; Secure Societies	***Health*** - Makerere University; Mbarara University of Science and Technology ***Agriculture, Energy, Transport, eInclusion, Secure Societies*** - Makerere University ***Environment*** - Geological Survey and Mines; Makerere University

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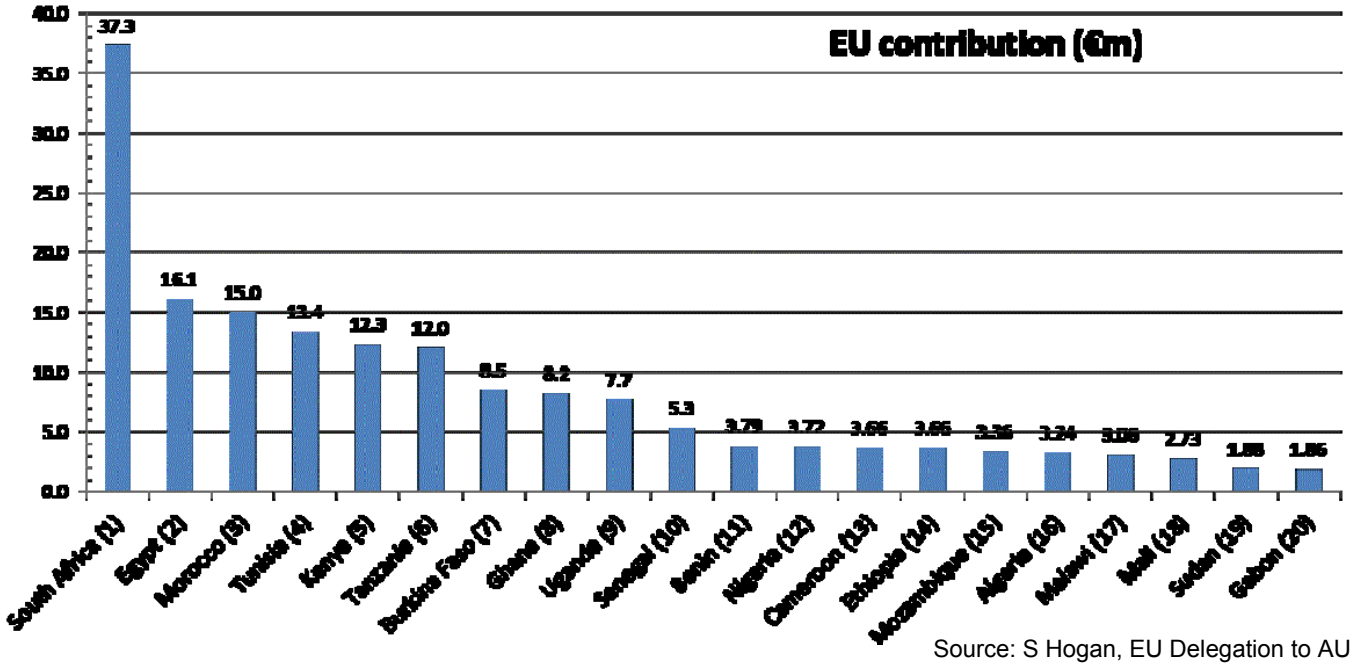
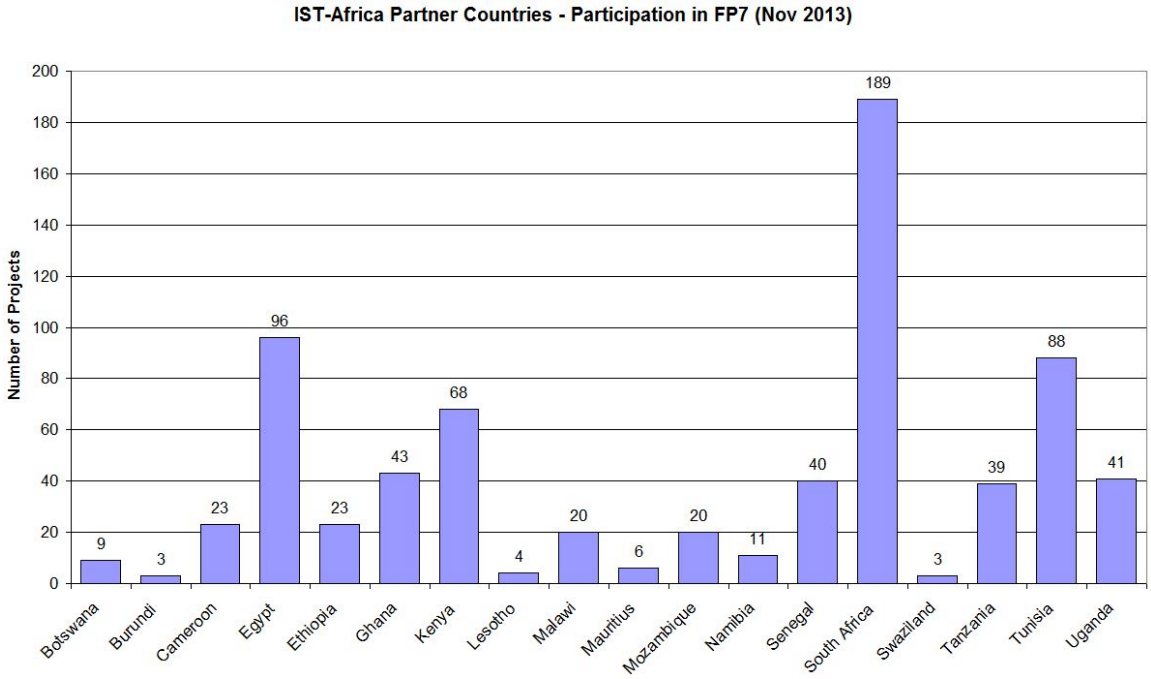
1.5 National Participation in FP7

As at September 2013, there were 1,315 participations from 45 African countries in 565 FP7 projects, with total EU-funding to African partners of €178 million. The diagram below outlines the leading African countries in terms of the total level of EU research funding secured:



Source: S Hogan, EU Delegation to AU

The level of participation under FP7 by organisations from IST-Africa partner countries has grown significantly over the past seven years as illustrated in the diagram below.



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.

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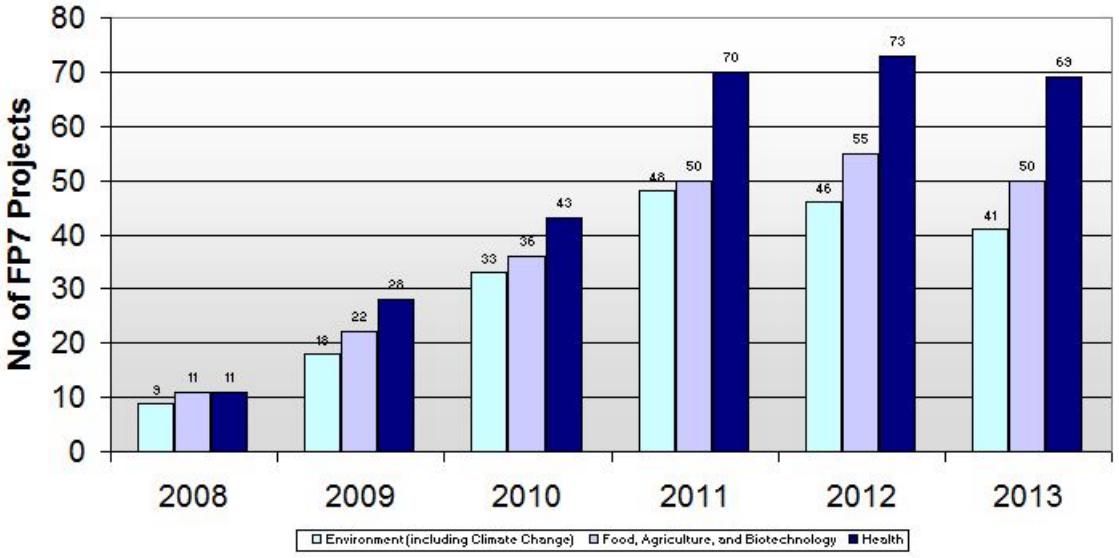
The two diagrams below illustrate the number of FP7 projects running in different thematic areas per year that incorporated European and African partners (from IST-Africa partner countries). It is clear that a significant number of projects under Environment, Food & Agriculture and Health ran from 2010 - 2013. The second diagram outlines the number of FP7 projects running per year in the other themes. In the case of ICT it is important to remember that while specific projects were funded under ICT calls, ICT components were also included as a horizontal enabler in projects funded under other thematic Calls.

Environment, Food & Agriculture and Health FP7 Projects with European and African Beneficiaries from IST-Africa Partner Countries



Thematic Breakdown of FP7 Projects with European and African Beneficiaries from IST-Africa Partner Countries

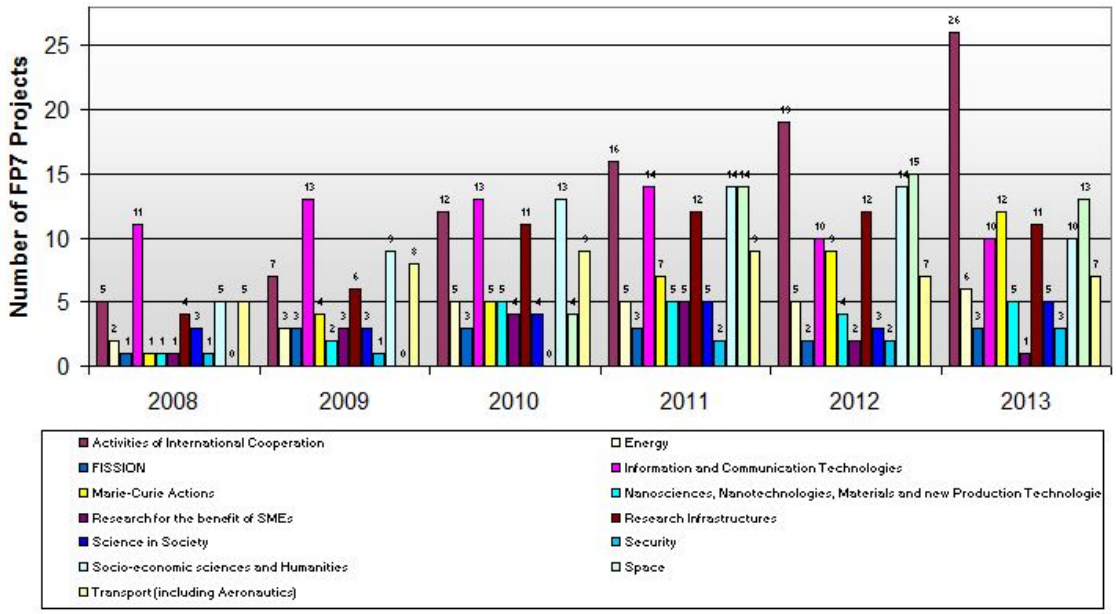


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Table 5 below provides a summary of FP7 participation by IST-Africa partner country:

Table 5: FP7 participation by IST-Africa partner country

Country	No. of FP7 projects	No. of national organisations involved	No. of European/Associated country organisations involved
Botswana	9	5	40
Burundi	1	1	1
Cameroon	23	15	169
Egypt	96	48	645
Ethiopia	23	17	149
Ghana	43	22	195
Kenya	68	37	417
Lesotho	4	1	1
Malawi	20	10	76
Mauritius	6	3	18
Mozambique	20	9	95
Namibia	11	5	78
Senegal	41	20	283
South Africa	189	71	1,097
Swaziland	3	2	4
Tanzania	39	19	170
Tunisia	87	51	522
Uganda	41	17	195

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, January 2014, ISBN: 978-1-905824-42-7.

1.6 Conclusion

While the targeted countries are at different socio-economic levels, improving eInfrastructures and having a good legal framework to support ICT activities are seen as being priorities moving towards becoming Information Societies. There are a good range of ICT Initiatives ongoing at national level in relation to eInfrastructures, Innovation and Entrepreneurship, eGovernment, eHealth, Cyber Security and ICT Skills Development. A number of the countries have established National Research Educational Networks to support networking and access to Digital Repositories across Higher Education Institutes.

This study documents the current state of ICT and Innovation related policy making, infrastructure, initiatives, national ICT research priorities, research focus within Higher Education Institutions, priority areas in the context of the ICT-39 Call of Horizon 2020 as well as an initial mapping of research capacity to Horizon 2020 Leadership in Enabling and Industrial Technologies (LEIT) and Societal Challenges priorities and national participation in FP7 across the 18 IST-Africa partner

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countries in North Africa (Egypt, Tunisia), West Africa (Senegal, Ghana), East Africa (Burundi, Ethiopia, Kenya, Tanzania, Uganda), Central Africa (Cameroon) and Southern Africa (Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland).

In an African context ICT must be seen as a horizontal enabler in all areas of Service delivery - eHealth, eGovernment, eAgriculture, eEnvironment, eEducation and eInfrastructures. This requires a multidisciplinary approach including thematic experts, computer scientists and user interface experts for example. The ability to deliver services via mobile phones is also critical. Common research areas across most IST-Africa partners include Health, Cloud Computing, Food Security and Sustainable Agriculture, Enviroment and Energy and Technology-enhanced Learning.

The level of participation in Framework Programme 7 has grown significant across the IST-Africa partners countries over the past seven years. This has had a positive impact in relation to the research being undertaken and has laid a solid foundation for future collaboration under Horizon 2020. There is now a greater awareness of the benefits of international collaborative research and a good network of collaborators has been established.

Diagram 3 and 4 above provide visual representation of priority themes in the context of the ICT-39 H2020 Call and an overview of some of the national partners who have research expertise in the selected themes for ICT-39.

An initial mapping of research areas relevant to Horizon 2002 has been undertaken to raise awareness of specific African institutions with the capacity to participate in proposals submitted in cooperation with their European peers. Horizon 2020 is completely open to International Cooperation. Existing partnerships should take the opportunity to look carefully at upcoming calls under Horizon 2020 including the ICT-39 Call as a mechanism to continue their successful collaboration, knowledge transfer and capacity building.

Tables 3 & 4 above provide an overview 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.

This study is complemented by two other IST-Africa studies entitled "Guide to Living Labs and Innovation Spaces in IST-Africa Partner Countries", November 2014, ISBN: 978-1-905824-49-6 and “Guide to Bilateral & Multilateral Cooperation Agreements Supporting ICT/STI-related Activities in IST-Africa Partner Countries”, November 2014, ISBN: 978-1-905824-48-9. All three studies will be updated during 2015.

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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 2.155 million inhabitants (estimate July 2014, CIA World FactBook) and a literacy rate of 85.1%. 63% percent of the total population is between 15 and 64 years of age. Gaborone, the capital city, has a population of about 233, 135 (2011). 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 mining of diamonds, which collectively make up one of the world's largest diamond reserves. The revenue earned from diamonds drive Botswana's 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 and are not sustainable. The Government established a Botswana and Economic Advisory Council (BEAC) in August 2005. BEAC then developed a strategy called "Botswana Excellence -- A Strategy for Economic Diversification and Sustainable Growth" and the "Action Plan". The Action Plan details projects aimed at driving implementation of the Economic Diversification and Sustainable Growth Strategy. The Action Plan and the Strategy were approved by Cabinet in December 2006 and November 2008 respectively.

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. It is in this context that Botswana's first National Information and Communications Technology Policy was approved by Parliament in 2007 [Maitlamo National Policy for ICT Development 2007].

In December 2010, an ICT Committee was constituted in the National Assembly. This is 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.

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

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and partnerships. ICT, Innovation and the Information Society at large are highlighted as a key tool for achieving its development objectives.

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

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)). A new regulatory body, Botswana Communications Regulatory Authority (BOCRA) was formed to assume responsibility over the regulation of the communications sector in Botswana, comprising telecommunications, Internet and Information and Communications Technologies (ICTs), commercial radio and television communications broadcasting, postal services and related matters.

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 telecommunications, according to Botswana Communications Regulatory Authority at December 2013 there were 174,165 fixed phone lines subscriptions, 3.246 million mobile phone subscriptions and 21,590 broadband subscriptions. According to the BTA 2013 Annual Report, tele-density of mobile telephony was 153% in March 2013 and Internet usage (mobile and fixed) has increased from 13.8% in March 2012 to 48% in March 2013.

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.

There are 2 public universities and 2 private institutions of Higher Education with 4 Departments focused on ICT/Engineering. There are also eight public Higher Education Institutes including DVET and nine private Higher Education Institutes.

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2.2 ICT Background

The National Information and Communications Technology (ICT) Policy builds on Government initiatives and aims to assist in achieving Vision 2016 by serving as a key catalyst in achieving social, economic, political and cultural transformation within the country.

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

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 Electronic Communications and Transactions Bill were approved in 2013.

The implementation of the National Public Key infrastructure (PKI) is envisaged.

2.2.1 ICT Infrastructure

Several projects aimed at positioning Botswana as a regional ICT hub have been undertaken over the past few years.

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 [BT, Cable and Wireless], US [AT&T, Sprint] and Canada [Tele-globe] as well as direct connectivity to London through SAT3 undersea cable.

Botswana invested in fibre-optic networks locally and international to ensure good communication infrastructure. These include: NEPAD-Led Undersea Cable, East African Submarine System

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(EASSy), West African Festoon System and West Africa Coast Cable System (WACS). The access point for EASSy is at Mtunzini, South Africa and the access point for WAC is located at Swakopmund, Namibia.

The National Backbone (TransKalahari Fibre Optic Ring) was installed in 2008 and funded by Botswana Telecommunications Corporation (the incumbent fixed line operator). The cross border fibre optic cable connections connect Botswana to South Africa, Namibia, Zambia and Zimbabwe.

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.

BTC completed upgrading its national Management Data Network [MDN] and the Asymmetric Digital Subscriber Line [ADSL]. 2006/07 saw the successful launch of broadband services in most parts of the Botswana with plans to support the Education, Healthcare, Libraries and other public sector needs [BTC Annual Report 2007]. A network utilizing fibre-optic cables previously [Metropolitan Area Network] initially reserved for key business areas was also rolled out o support existing services and launch new services. This initiative becomes the first commercial Multi-Protocol Label Switching [MPSL] deployment in Botswana.

The revision of the Cost Model and Pricing Framework for Communication Services in 2011 lead to a reduction in wholesale and retail tariffs.

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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.

2.3 Current ICT Initiatives and projects

ICT Initiatives primarily focus on Digital Divide, eGovernment, Innovation and Entrepreneurship including:

- Connecting Communities Programme
- Kitsong Centres
- Thuto Net
- Government On-Line
- Botswana Innovation Hub
- BTC Privatisation & Formation of Botswana Fibre Network (BOFINET) company
- Broadband Strategy & Universal Access and Services (UAS)
- Digital Migration
- Pan African e-Network Project

2.3.1 Connecting Communities Programme

This Programme is 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 **NTELETSA 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 were 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).

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

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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 set up as Community initiatives.

2.3.3 Thuto Net

The Thuto Net program was an expansive project that incorporates the **Schools Connectivity Initiative,** to link all secondary schools to the Internet. All secondary schools in Botswana have computer laboratories comprising about 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.

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: www@gov.bw Ministry of Trade & Industry, Internally Funded
- Trade Permit s & 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.

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

2.3.5 Botswana Innovation Hub (BIH)

The concept to develop the Botswana Innovation Hub (BIH) commenced in 2008 in tandem with development of Botswana's ICT infrastructure and Botswana Excellence Strategy to support economic diversification, job creation and transition to a knowledge economy.

BIH is primarily focused on four sectors through which businesses, research and training can be provided: Information and Communications Technology (ICT), Bio-Technology, Energy and Mineral Technology. It is responsible for stimulating start-ups, providing an enabling environment for investors and developing and managing Botswana's first Science and Technology Park. The development of the National Science Park is due for completion during 2016.

Programmes include the First Steps Venture Centre, Microsoft Innovation Centre, Cleantech and KitsoWorks. BIH is receiving support through the Southern African Innovation Support (SAIS) Programme funded by Ministry of Foreign Affairs of Finland to establish a Global Business Lab 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 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.

2.3.6 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 is 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. 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).

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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 plans that the finance raised will support BTC's current network expansion plans.

2.3.7 Broadband Strategy & Universal Access and Services

The development of a five-year Broadband strategy is now at the final stages with the Draft Broadband Strategy being made available in August 2013. 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 under development for some time. BOCRA published a draft Universal Access and Service Fund Manual in April 2014. The vision of the Universal Access and Services Policy is that all Botswana will have Universal service with affordable voice communications and access to Internet and ICT services, regardless of their location within the country.

2.3.8 Digital Migration

The digital switchover process is happening all over the world. In South Africa & Europe the target date for completion of digital switch over is 2011 & 2012 respectively. It was agreed at the International Telecommunication Union (ITU) Regional Radiocommunications Conference in 2006

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that by 2015 African and European countries should have completed the digital switchover. Botswana Television (BTV) and Gaborone Broadcasting Company (GBCTV) are currently transmitted through analogue transmitters.

In Botswana, a Reference Group was established on 07 February 2008 to kick start the digital switchover/migration process. The Minister of Communication, Science and Technology (MCST) (now Ministry of Transport and Communications) established a Digital Migration Task Force to develop a roadmap on how the country can migrate from analogue to digital television. ISDB-T was chosen after "a thorough process of research and evaluation of available options" comparing DVB-T2 and ISDB-T. The digital migration broadcasting was launched in Botswana in July 2013.

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, Entrepreneurship

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**[2] - Advance Computing; Information Management; Components and Systems; eInfrastructures
- University of Botswana, Harry Oppenheimer Okavango Research Centre[3]
- **University of Botswana, School of Medicine** – Health/ eHealth Sciences; eInfrastructures; Simulations
- **Botswana International University of Science and Technology (BIUST)**[4] – CITE Department – ICT for Healthcare, Technology-enhanced Learning, Resource efficiency; MEGE Department

[2] http://www.ub.bw/learning_progs.cfm?pid=587
[3] http://www.orc.ub.bw/
[4] http://www.biust.ac.bw/

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– Transport, Energy; Applied Sciences – Cyber Security; Earth & Environmental Sciences – Embedded Systems, Wireless Communications, Robotics, Software Simulation

- **Limkomkwing University of Creative Technology**[5] - Faculty of ICT – Technology-enhanced learning, Advanced computing architecture, Future Internet (Interactive multimedia, wireless communication)
- **Botho University**[6] - 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 Technology Centre (BOTEC)[7]

2.4.3 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	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
Technology-enhanced Learning	Limkomkwing University of Creative Technology (Faculty of ICT); Botswana International University of Science and Technology (CITE Department)

2.4.3 Mapping to H2020 Themes

Based on an initial consultation process, 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 **Limkomkwing University of Creative Technology -**

[5] http://www.limkokwing.net/botswana/
[6] http://www.bothocollege.ac.bw/
[7] http://www.botec.bw/

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	Faculty of ICT – Processor and System Architecture, Simulation Software
Future Internet	**University of Botswana Computer Science Dept** - Networks **Limkomkwing 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	**Limkomkwing 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 Learning **Botswana Accounting College – Department of Computing and Information Systems** - Technology-enhanced learning, content access and analytics
Robotics	**Botswana International University of Science and Technology (BIUST) - Earth & Environmental Sciences –** Robotics **Botho University - Faculty of Computing** – Robotics

Horizon 2020 Societal Challenges	**Institution, Relevant Dept and Research area**
Health	**University of Botswana, School of Medicine** - Health/ eHealth Sciences **Botswana International University of Science and Technology (BIUST) – CITE Department** – ICT for Healthcare **Botswana Accounting College – Department of Computing and Information Systems** - Data analytics for Health
Food Security, Sustainable Agriculture	**Botswana National Veterinary Laboratory** Research on Animal Health: Epidemiology & control of foot and mouth disease, Causes of infertility in cattle, sheep & goats Research on Foot Safety: Human causing disease bacteria in meat and milk, chemical & antibiotic residues

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	in meat Research on Public Health - Epidemiology & control of zoonotic diseases (e.g. rabies, anthrax) at the human/animal-wildlife interface **Botswana National Food Research Centre** – Food Technology; Food Biochemistry; Food Microbiology & Biotech; Nutrition & Dietetics; Extension & Training
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	**Botswana International University of Science and Technology (BIUST) –Applied Sciences –** Cyber Security **Botho University - Faculty of Computing** – Cyber Security

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) funded by Ministry of Foreign Affairs of Finland (2011 – 15) will also assist in building international partnerships.

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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 10,395,931 inhabitants (July 2014 est. CIA World FactBook) with a literacy rate of 67.2%. 51.8% of the total population is between 15 and 64 years of age. The capital city is Bujumbura with a population of 605,000 (2011). Kirundi is the national language with French as the official language. Other languages spoken are Swahili and English.

Burundi joined the East African Community, which improves 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 17,400 fixed phone lines in 2012 (32,600, 2010) and 2.53 million mobile phones in 2013 (2.4 million 2012) according to Agence de Regulation et del Controle des Telecom. There are six ISPs, with approximately 500,000 Internet users in May 2013 (ARCT).

In terms of ICT Infrastructure the Government of Burundi in cooperation with the World Bank have commencing 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 U-Com, Onatel Burundi, Econet Wireless Burundi, Africell Burundi, Lacell SU and Vietnam's Vietell Telecom (recently licence). Two mobile operators in Burundi have launched 3G broadband in the expectation of reduced Internet access costs.

There are 7 public universities and 24 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.

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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).

Despite the liberalisation of ICT, Burundi still faces a number of challenges in relation to the ICT adoption. Investment in ICT for Higher Education planned during 2012 – 2013 was to include development of a common telecommunications infrastructure, interconnection of workstations and development of software to manage Bachelor and Master Programmes. Burundi's national budget for 2011 – 2012 included an allocation for agriculture R&D. It also included allocations for ICT with emphasis on improving infrastructure for the application of ICT (ongoing fibre optic project).

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.

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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) is operational and was officially launched by President Pierre Nkurunziza on 21 January 2014. President Nkurunziza confirmed the investment of $25 million in the fibre optic project as a public private partnership to increase access to broadband and reduce costs.

3.3 Current ICT Initiatives and Projects

ICT Initiatives are primarily focused on eInfrastructure and eGovernment.

3.3.1 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.

3.3.2 Establishment of National CIRT

ITU is implementing the establishment of the National Computer Incident Response Team (CIRT) in Burundi. This project aims 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 commenced in January 2013 and is due to be completed in February 2015.

3.3.3 Regional Communications Infrastructure Project

This regional project is 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.

3.3.3 Burundi Education and Research Network (BENET)

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

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membership in UbuntuNetAlliance and acquired a block of IP addresses from Afrinic. BERNET is up and running as a non-profit Association in formation governed by an Executive Committee supported by an in-house Technical Team.

BERNET is in the process of seeking Legal Acceptance from the Ministry of Interior Affairs.

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 Course 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)

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- **Université Lumière de Bujumbura**[8]
  - Departments include: Faculté de Communication & Faculté d'Informatique de gestion;
  - Research areas include: Advanced Computing, Technology-enhanced learning
- **Université Espoir d'Afrique**[9]
  - 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: Faculte de Math – Informatique; Faculty of Medicine
  - Research areas include: Components and Systems, Technology-enhanced Learning, Health Sciences (Faculty of Medicine)
- **INITELMATIQUE** (Bujumbura)
  - Departments include: Informatics Engineering, Software Engineering
  - Research areas include: Component and Systems, Advanced Computing, Technology-enhanced learning
- **Université des Grands Lacs**[10]
  - Departments include: Faculté d'Informatique
- **Institut Supérieur des Technologies** (Bujumbura)
  - Departments include: Maintenance Informatics
- **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

There are approximately 30,000 students in Higher Education in Burundi, 11,000 of which attend the University of Burundi.

[8] http://ulbu.bi/
[9] http://www.hopeafricauniversity.org/
[10] http://www.ulpgl.net/

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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

The initial mapping to Horizon 2020 Research areas is summarised below:

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) INITELEMATIQUE (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	**University of Burundi, Faculty of Medicine:** Malaria, HIV SIDA, Neglected tropical diseases, Telemedicine application; **Faculty of Sciences**: Phytochemicals & Traditional medicine **National Institute of Public Health (INSP):** Malaria, HIV SIDA, Neglected tropical diseases **East Africa Community (EAC) Centre of Excellence in Public Health Training** **Université de Ngozi, Health Science Institute/Faculty**: Malaria, HIV SIDA, Neglected tropical diseases **Université Espoir d'Afrique, Faculty of Medicine:** Public health
Food Security, Sustainable Agriculture	**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** **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. **Institute of Agronomic Sciences** (ISABU) (Ministry of Agriculture and Livestock) - focus on maize, rice, cassava, potatoes, livestock etc. **Université de Ngozi, CERADER**: Vegetable seeds multiplying; **AGROBIOTECH**: banana tissue culture
Energy	**REGIDESO** (water and hydropower supply) **ONATOUR** (Peat Supply) **University of Burundi** (Renewable Energy)

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 changes when importing ICT equipment and the development of partners in ICT Networking (such as participation in the IST-Africa Initiative).

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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 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.

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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 in to fifty-eight (58) divisions and further subdivided into 375 districts currently in the process of decentralisation. The population as at July 2014 was estimated at 23.130 million inhabitants with a literacy rate of 71.3% (CIA World Factbook). 53.9 percent of the total population is between 15 and 64 years of age. Yaounde, the capital city, has a population of 2.43 million (2011) and Douala has a population of 2.449 million (2011). 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 2012 figures (CIA World FactBook), there were 737,400 fixed phone lines in use compared with 13.1 million mobile phones. There were 10,207 Internet hosts (2012) and 749,600 Internet users (2009).

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 is currently establishing the national IXP and the project is expected to be finished during Q1 2015. There are 60 operational tele-centres, 110 being put into service and 15 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

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Maroua and University of Bamenda), over 80 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 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 is undergoing 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. The National ICT and Telecommunication Strategy is being revised and it is expected that the updated Strategy will be adopted in Q1 2015.

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

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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:

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- 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.

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 2013, Cameroon's Telecommunication Regulatory Board estimated market penetration rates in Cameroon's telecoms sector to be: mobile (69%), Fixed/fixed-wireless (3.6%) and Internet (6.6%). Nexttel, Vietnam's telecom operator commenced activities in September 2014 and is the first to roll out a 3G network in Cameroon.

4.3 Current ICT Initiatives and projects

Over the past few years, there have been a number of national initiatives 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 analysis phase with financial and technical help from European Union
- Computerisation of National Identity Card by the Delegation of National Security;
- 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.

External initiatives include:

- Definition of National Information and Communication Plan (NICI Plan) by UNECA;

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- 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

4.3.1 The National Electrification Project

The electricity supply in Cameroon is below consumer's satisfaction as there are power shortages even in some parts of the major towns hence 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.

In this regard, 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) will commence soon.

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.

In line with the National Strategy for ICT Development, certain programs or projects were identified in September 2009. Most of the projects listed below 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 beyond 2012.

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

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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 judiciary will be computerised while the process of computerising identification cards in Cameroon continues. Projects for territorial security include: Data center deployment, putting in place of a Public Key Infrastructure and a certification authority.

Geographic scope, cost and time frame: National, 22 336 259 000 francs CFA, 2010 - 2013

4.3.5 ICT Infrastructure Development

The national ICT infrastructure is almost obsolete. However, 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 and densify the telecommunications network and Internet development through the implementation of the electronic communications infrastructure development program. The following projects to develop communications infrastructure were identified: National backbone infrastructure (more than 6,000 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, currently 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

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intensified the process of securing the Cameroon's cyberspace with PKI by planning key government applications to be secured in 2015. These applications include: the e-Procurement system, tax management system, Importation/Exportation Payment 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

General observation shows that the use of ICT is low in both public and private sectors and within the general population. In this era of information society, ICT is an indispensable tool for human development.

To this end, the Government undertakes to ensure ownership of ICT in the sectors of health, education, agriculture or rural development.

Within the framework of the Pan-African online services project with the government of India, three projects at pilot stages have been realized. They include:

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.

In this light, 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

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'.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 most of which are still in the emerging (limited web presence) stage and a government intranet will be developed.

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 is expected to be adoption in Q2 2015

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;

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- 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

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

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- 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	925	275
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

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

- **University of Yaounde I**[11]
  - 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**[12]
  - 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**[13]
  - 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**[14]
  - 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**[15]
  - 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**[16]
  - Departments include: Faculty of Sciences, Department of Computer Science; Faculty of Engineering, Department of Computer Engineering

[11] http://www.uy1.uninet.cm/
[12] http://www.univ-douala.com/
[13] http://www.univ-dschang.org/1.8/index.php
[14] http://ubuea.net/
[15] Website under construction
[16] Website under construction

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- **University of Ngaoundere**[17]
  - 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-

[17] http://www.univ-ndere.cm/

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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 the following thematic areas are considered to be important in the context of the ICT-39 Call:

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)
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)
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)

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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)

4.4.4 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	**University of Dschang (Math/CS):** Smart Embedded Components and Systems, Large Area Integration and Complex System Engineering **University of Maroua (Computer/Telecom):** Smart Embedded Components and Systems, and System of Systems; **University of Ngaoundere (Math/CS):** Complex Systems, Communicating Systems.
Advanced Computing	**University of Dschang (Math/CS)**: Interconnect and Data Localisation Technologies, Cloud Computing, Parallel Computing and Simulation Software **University of Ngaoundere (Math/CS):** Processor and System Architecture, Cloud Computing and Parallel Computing.
Future Internet	**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 **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 **University of Maroua (CS/Telecommunication):** Model Based Software Engineering, Cloud Computing **University of Douala (Math/CS)**: Numerical methods, Software Modelling; **Faculty of Industrial Engineering (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-

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	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
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.
Energy	**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. **University of Maroua (Computer/Telecom):** Reducing energy consumption and carbon footprints by smart and sustainable use, Low-Cost.
Transport	**University of Maroua (Computer/Telecom):** Resource Efficient Transport that respects the environment; Socio-Economic Research
Climate Action, Resource Efficiency and Raw Materials	**University of Ngaoundere (Math/CS):** Protection of Environment, Sustainable Management of Natural Resources, Observation and Information Systems
Inclusive, Innovative and Reflective	**University of Maroua (Computer/Telecom):** cultural

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Societies	heritage
Secure Societies	**University of Maroua (Computer/Telecom):** Cryptography, Cyber Security; Risk and Management; Enhance Standardisation and Interoperability of Systems, Including for Emergency Purposes. **University of Ngaoundere (Math/CS):** Cyber Security, Privacy and Trust

Level of Research Maturity

Cameroon has a good research base and experience in 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.

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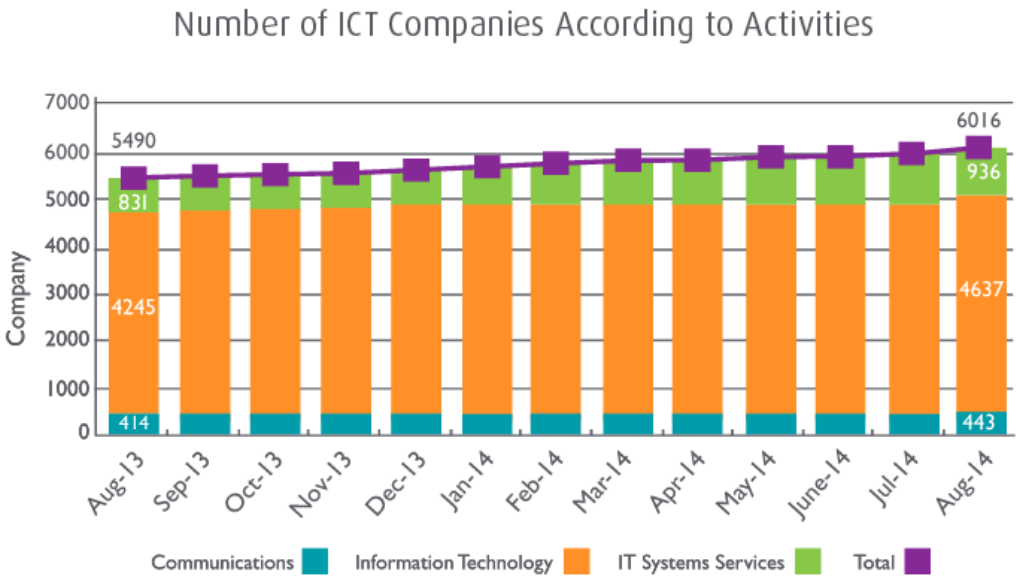
5. EGYPT

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 86.89 million inhabitants (July 2014 CIA World FactBook) with literacy rate of 73.9%[18]. 62.9% of the total population is between 15 and 64 years of age. Cairo has a population of 12 million and Alexandria 4.387 million (2014). The official languages are Arabic, English and French.

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. There were 6,016 ICT companies registered as at 30 August 2014.



Source: Ministry of Investment
General Authority for Free Zones and Investment

[18] CIA World Factbook

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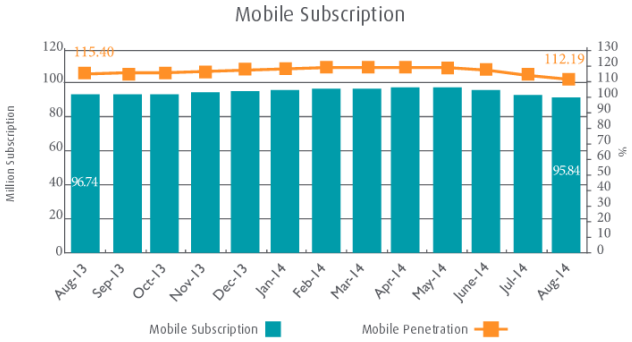
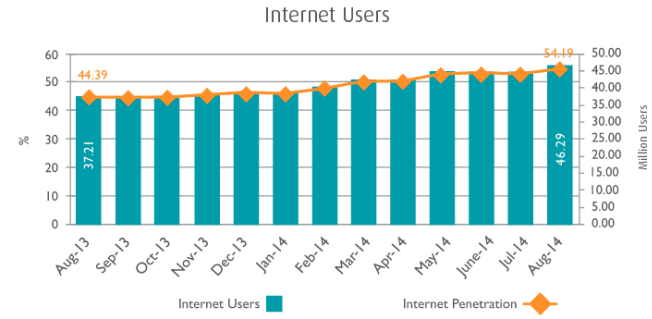
In relation to Communications, according to MCIT and NTRA published statistics, there were 6.69 million fixed line subscribers and 95.84 million mobile subscribers (112.19% penetration) as at 30 August 2014.



Source: Ministry of Communications and Information Technology
National Telecom Regulatory Authority



Source: Ministry of Communications and Information Technology
National Telecom Regulatory Authority - Telecom Egypt

In terms of Internet usage, there were 46.29 million Internet users (54.19% penetration), with 2.93 million ADSL subscribers and 20.28 mobile Internet users as at 30 August 2014.

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, with over 8.6 million subscribers as at April 2013. 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 three mobile providers.

CAIX[19], 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 safe their international bandwidth. All Class A ISPs are members in CAIX. There are four ISPs (TEDATA, Vodafone, Linkdotnet, Etisalat) connected via giga interface and three ISPs (Noor, MenaNet, YALLA) via Fast Ethernet.

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.

[19] www.caix.net.eg

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There are 29 public universities, 33 private universities and more than 400 private institutions of higher education. Of these 35 have Departments focused on ICT/Engineering.

5.2 ICT Background

Emphasis is placed on applied ICT research and development to support Egypt to be a world-class competitor. There has been progress as Egypt is no longer dependent on natural resources and is focused on creativity and innovation. To boost this concept, 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. The MCIT R&D 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 Centre[20] (TIEC) aims to support innovation and entrepreneurship in ICT and thus drive the economy.

Egypt's ICT Policy (2013 – 2017) has been published in Arabic. In the formulation of this strategy, the primary consideration 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 Identify 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.

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.

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.

[20] http://www.tiec.gov.eg/en-us/Pages/default.aspx

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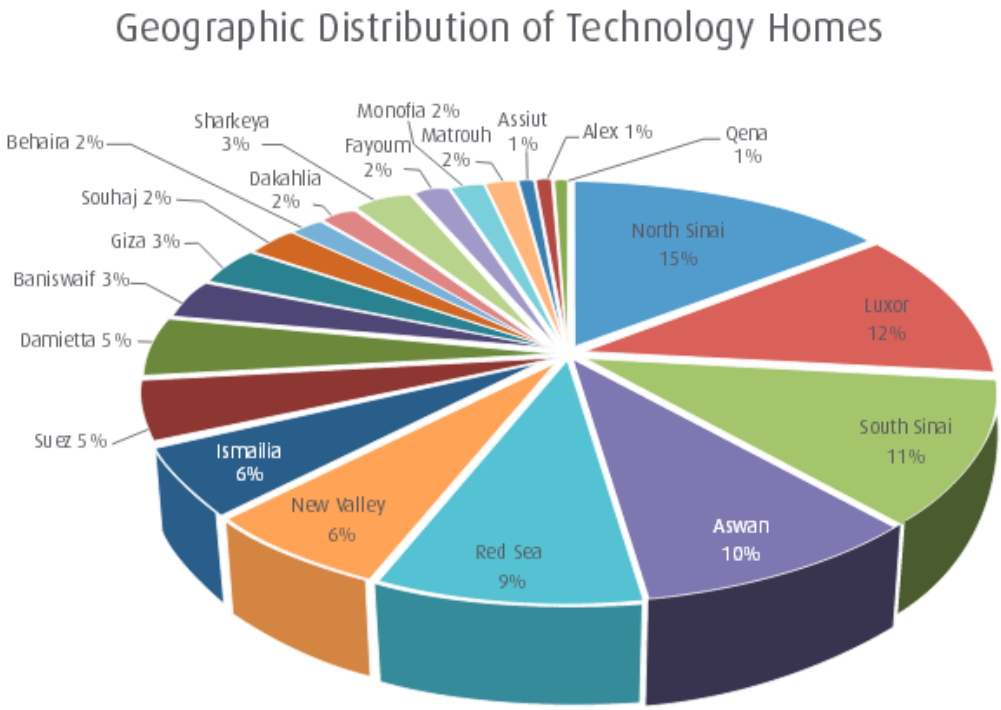
In September 2011, MCIT launched the IT Houses initiative to offer training courses, eGovernment service and SMS services. As at August 2014, there were 126 IT Houses established across the country. There were 2,163 IT Clubs of which 1,955 are connected to the Internet.



Source: Ministry of Communications and Information Technology
Training and Human Resources Department

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. Egypt's ICT 2020 Strategy is currently being finalised and aims to support the development of the communications sector both regionally and internationally.

5.3 Current ICT Initiatives and projects

5.3.1 ICT for Learning

MCIT has invested in projects and programs to support sustainable human development which incorporate the following components:

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

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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 is inspired by pursuing equal opportunities for health services anywhere in Egypt, and expanding medical insurance to all citizens.

The principle objectives of the e-Health initiative are as follows:

- **Extend** better medical diagnostic services to rural areas
- **Provide** a training facility for the medical community
- **Acquire** international consultations for special cases
- **Reduce** the cost of health care through better patient management
- **Optimize utilization** of expertise and resources
- **Provide** an advanced medical services in emergencies
- **Create** an electronic databases for medical records

The main components/ projects of this initiative are:

- Emergency Medical Call Center and Ambulance Service
- National Network for Citizen Health Treatment
- Information System Units in Governmental Hospitals
- National Healthcare Capacity Building Project
- Pilot Project for Hospital Automation
- Women's Mobile Health Unit Project
- National Cancer Registry Program
- The Suzanne Mubarak Center for Women's Health in Alexandria
- IT Health Master Plan
- National PACS Project
- Integrated National Health Record System

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). One of the core objectives of the initiative is to modernize the way citizens interact with their government by introducing ICTs to the internal operations of government departments and to their interface with the public.

The main components/ projects of this initiative are:

- National Land Registration System

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- Automation of Notarization Offices
- Prohibited from Transaction System Network
- Automation of Chambers of Commerce Project
- Egyptian Geography Network (EGN)
- Sheikh Zayed Geographic Information Systems Unit
- e-Commerce Map for Alexandria Chamber of Commerce
- 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. This initiative 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 components/ projects of this initiative are:

- Online Journalism
- CULTNAT
- National Archives of Egypt
- Fekr Rama Portal
- Luxor Portal
- Egynews Portal
- Science and Technology Portal
- Community Development Portals
- Telecentre Network
- The Egyptian Sign Language Dictionary CD

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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.

The main components/ projects of this initiative are:

- IT Clubs - In April 2013 there were 2,163 IT Clubs, with 1,955 connected to the Internet.
- 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 and 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. The initiative focuses on developing how citizens interact with Government bodies by applying ICT techniques in internal processes.

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 of this initiative are:

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

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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 components/ projects of this initiative are:

- ICT for Illiteracy Eradication
- Kenana Online Community Development Portal.

5.3.10 ICTs for People with Disabilities

In March 2012, MCIT launched the ICTs for People with Disabilities initiative, which aims 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 aims at removing barriers and facilitating 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.

In 2012, progress was made on a number of tracks, as follows:

- 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
- ICDL4PwDs Grant
- Employability Enhancement Program
- Tamkeen Competition
- Support of the National Council on Disability Affairs
- e-Learning for Schoolchildren with Hearing and Sight Impairments

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.

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- Technology Innovation & Entrepreneurship – Focus on encouraging creativity and Innovation with full government support for all stakeholders. Institutions involved include: Technology Innovation and Entrepreneurship Center (TIEC), Private sector (Cairo Hackspace, The District, icecairo Innovation Spaces).
- Health – Biomedical Informatics research is one of the main research areas in a lot of universities in Egypt. Institutions involved include: Ministry of Health, Information Technology Institute (ITI), Software Engineering Competence Centre (SECC) and Universities (Cairo University, Nile University, Beni Suef University, American University of Cairo, British University in Cairo, Zewel University).
- Academic initiatives to improve living conditions of Egyptian society - Citizen centric service delivery, Community participation, efficient allocation of government resources. Institutions involved include: MCIT, Software Engineering Competence Centre (SECC) Cairo University, Academy of Scientific Research and Technology

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 Engineering and Applied Sciences	12 Full time, 8 part-time, 10 visitors	96	575 Masters 27 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	

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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**[21]
  - 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

[21] http://cu.edu.eg/Home

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of Computer Information); Bioinformatics, Persuasive Computing, Networks (Systems and Biomedical Dept)

- **Helwan University**[22]
  - 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**[23]
  - 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

- **American University of Cairo**[24]
  - 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)**[25]
  - Departments include: Faculty of Informatics and Computer Science (ICS)
  - Research areas include: Cloud Computing, Cyber Security, Mobile-based Health Applications (self-service)

[22] http://www.helwan.edu.eg/english/
[23] http://www.nileu.edu.eg/
[24] www.aucegypt.edu
[25] http://www.bue.edu.eg/

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- **Heliopolis University**[26]
  - 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: Mediterranean Science, Policy, Research & INnovation Gateway; **ADA**: Establishment of a market for solar water heaters in Egypt

- **National Telecommunications Institute**[27]
  - 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**[28]
  - 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

[26] www.hu.edu.eg
[27] http://www.nti.sci.eg/
[28] http://www.iti.gov.eg

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- **Software Engineering Competence Center (SECC)**[29]
  - 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, Tecnalia 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.

- **Ain Shams University**[30]
  - Departments include Engineering
  - Research areas include: Future Networks, Embedded Systems, Language Technologies, Micro and nano-electronics, micro systems, Photonics, Microwave

- **Azhar University**[31]
  - 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,

[29] http://www.secc.org.eg/
[30] http://www.shams.edu.eg/
[31] http://www.azhar.edu.eg/En/index.htm

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Computers and Society (eLearning, eVoting, eBilling), Network protocols and programming (College of Computing and Information Technology)

- **Beni Suef University**[32]
  - Departments include: Faculty of computers and information
  - Research areas include: Cloud Computing, Technologies for IoT, Health data collection
- **Alexandria University**[33] (Future Networks, Embedded Systems)
- **Mansoura University**[34] (Future Networks, Embedded Systems)
- **Assiut University**[35] (Future Networks)

5.4.3 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	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**
eGovernment	Big Data	**Software Engineering Competence Centre**; **Sadeem**

[32] http://www.bue.edu.eg/
[33] http://www.alexu.edu.eg/index.php/en/
[34] http://www.mans.edu.eg/en
[35] http://www.aun.edu.eg/

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5.4.4 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	**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). Participated in RECOCAPE FP7 project in cooperation with ITIDA-SECC **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 **American University of Cairo**: Smart Embedded Components and Systems, Smart Integrated Systems **Heliopolis University (Faculty of Engineering):** Complex System Engineering: PV System, Wind energy solutions, Diesel Gen., UPS
Advanced Computing	**Nile University (Center for Informatics Science):** Software Engineering, Cloud Computing **American University of Cairo:** Processor and System Architecture, Parallel Computing and Simulation Software. **Heliopolis University (Faculty of Engineering):** Simulation Software **Egyptian National Scientific and Technical Information Network (ENSTINET)**: Parallel Computing
Future Internet	**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 Systems. Participated in the 4G (LTE) project funded by the National Telecom Regulatory Authority (NTRA) of Egypt **Helwan University (Faculty of Computers and Information Systems):** Human Computer Interaction, Cloud Computing, Data Mining, High Performance Computing, Mobile Computing **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

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	American University of Cairo: Networks, Software and Services, Cloud Computing, Cyber Security, Privacy and Trust **National Telecommunication Institute:** Networks, Cloud Computing, Cyber Security, Wireless Communication and Optical Networks **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 **British University in Egypt (Faculty of Informatics and Computer Science):** Cloud Computing **Arab Academy for Science, Technology & Maritime Transport**: High Performance Computing including Grid and Cloud Computing, Communication Antennas, Networks **Beni Suef University**: Cloud Computing, LTE Networks **ITIDA - SECC**: Service Oriented Architecture, Cloud Computing
Content Technologies & Information Management	**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 **Nile University (Center for Informatics Science):** Data Mining and Machine Learning, text mining, High Performance Computing, Peer to Peer Networking, ubiquitous computer, computing vision **American University of Cairo:** Technologies for Language, Learning, Big Data Technologies' Advanced Data Mining, Machine Learning, Statistical Analysis and Visual Computing **Egyptian National Scientific and Technical Information Network (ENSTINET)**: Big Data Technologies, Advanced Data Mining **Azhar University (Computer Engineering Dept):** Natural Language Processing, Content Technologies & Analysis **Arab Academy for Science, Technology & Maritime Transport**: Data mining, eLearning, Informatics **Cairo University (Faculty of Computer Information):** Information Management including Big Data, Content Management and Content Technologies **ITIDA - SECC**: Semantic web and Semantic data management
Robotics	**Nile University (FACT (Festo Authorized Automation and Certified Training Center) for training in Mechatronics and Automation, Center for Informatics**

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	Science): Robotics
Key Enabling Technologies: Micro - Nano- electronics and Photonics	**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 **Ains Shams University (Engineering Dept):** Micro and nano-electronics, micro systems, Photonics **Cairo University (Faculty of Engineering, Electronics and Communications Dept):** Micro and nano-electronics, micro systems.

Horizon 2020 Societal Challenges	**Institution, Relevant Dept and Research area**
Health	**Nile University (Center for Informatics Science, Center for Nanotechnology):** Medical Image Processing, bio-informatics **American University of Cairo:** Improved diagnostics, Expert Systems and Knowledge Discovery **British University in Egypt (Faculty of Informatics and Computer Science):** Mobile-based Health applications **Beni Suef University**: Health data collection and manipulation
Food Security, Sustainable Agriculture	**Nile University (Center for Informatics Science):** Bio-informatics **Heliopolis University (Heliopolis Academy Lab for Biodynamic Agriculture and medicinal plants):** Sustainable Agriculture, Sustainable and Competitive Agri-food Sector **National Research Centre (Nutrition Dept):** Food Security, Sustainable Agriculture
Secure, Clean and Efficient Energy	**Nile University (Nano Electronics Integrated Systems Center, Center for Nanotechnology):** Renewable Energy, Smart Electricity grids, wireless electricity, energy harvesting. **American University of Cairo:** Renewable Energy, Energy Efficiency, Smart Cities (Worked on project funded by Ericsson to manage Traffic Signals using ICT in a city **Heliopolis University:** Alternative Fuels and Mobile Energy Sources
Climate Action, Resource Efficiency and Raw Materials	**Nile University (Nano Electronics Integrated Systems Center, Center for Informatics Science):** Wireless Sensor Networks (MEMS sensors).
Transport	**National Telecommunication Institute:** Smart Transport

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	Systems
Climate Action, Resource Efficiency and Raw Materials	**Heliopolis University:** Eco-Innovation, Sustainable Management of Natural Resources, Transition Towards a Green Economy
Inclusive, Innovative and Reflective Societies	**Nile University:** Social entrepreneurship **Heliopolis University:** eLearning, eCulture **Bibliotec of Alexandria (CULTNAT):** Heritage Visulaisation, Cultural Heritage
Secure Societies	**Nile University (Center for Informatics Science, Information Security graduate program):** Information Security -risk and management. **American University of Cairo:** Cyber Security

Level of Research Maturity

Egypt has a vibrant research community with strong experience in collaborative research having secured participation in over **96** projects and securing research funding of over **€16.1 million** under FP7. 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.

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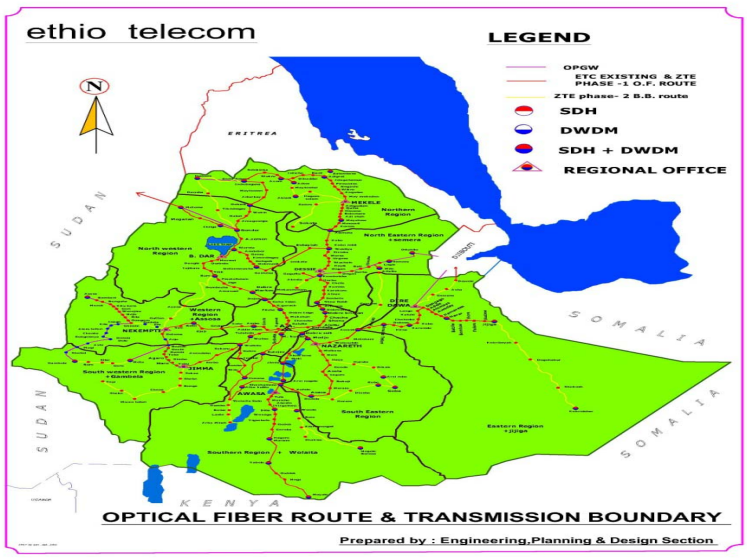
6. ETHIOPIA

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 96.6 million inhabitants (July 2014, CIA World Fact Book) with a literacy rate of 39%. Ethiopia is Africa's oldest independent country and its second largest in terms of population. Almost 53% of the total population is between 15 - 64 years of age. Addis Ababa, the capital city, has a population of 2.8 million (2009 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.

In terms of economy, Ethiopia is one of the fastest growing non-oil economies in Africa. It is heavily dependent on agriculture (accounts for 46% of GDP and 85% of total employment), which is often affected by droughts (2013, 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 12,000 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.

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There were 797,500 fixed telephone lines in use in 2012 compared to 20.5 million mobile phones. There were also 179 Internet hosts (2012) and 447,300 Internet users (2009). MCIT has established 200 Community Information Centres and 11 community radio stations to date in remote areas of the country to provide information on new ICT technology transfer and implementations, healthcase, 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 31 public universities and 42 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 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.

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.

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The National ICT Policy and Strategy 2009[36] plans 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 are 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 is 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 consists 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.

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

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The National Science, Technology and Innovation (STI) Policy (2012)[37] 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 conclusive 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.

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.

Over the past few years, there have been a number of national initiatives 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.

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

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6.3.1 eGovernment Initiatives

6.3.1.1 National Data Set

This project aims 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 is in progress.

Coverage: All Ministries and Agencies of Ethiopia

Project Duration: The expected project duration is 1.5 to 2 years.

6.3.1.2 National Enterprise Service Bus (NESB)

The objective of this project is to provisioning 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 is in progress.

Coverage: All Ministry and agency application identified in the eGovernment strategy

Project Duration: The expected project duration is 1.5 to 2 years.

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

Coverage: Nationwide initiative for issuance and use of PKI for all electronic transactions for government and private

Project Duration: The expected project duration is 1.5 to 2 years.

6.3.1.4 EthioICT-Village

MCIT is in the process of setting up the EthioICT-Village in an area of 200 hectare 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 conductive 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 first phase with an area of approximately 70 hectares is currently under construction.

Funding sources: Government of Ethiopia

6.3.1.5 WoredaNET

WoredaNET is an eGovernment network connecting more than 600 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

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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 will be delivered.

Funding source: Government of Ethiopia

6.3.1.6 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

6.3.1.7 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 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 Tigray.

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

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standardized training programme on entrepreneurship, business plan development and incubation services.

Geographic scope: Tigray Region

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 among other projects that aim to provide connectivity and specialised applications for schools and local governments. The project was launched to build and deliver highly interconnected and high performance networks for Universities and other Educational and Research Institutions in Ethiopia. More specifically EthERNet was aimed to build and deliver high performance networking that connected these institutions in the world, and by doing this to enable them to share educational resources and collaborate both within Ethiopia and globally.

Currently EthERNet has a network with 20Mbit/sec or better bandwidth that ties many of the established universities in Ethiopia. In addition, plans have been made to build the next generation network that would provide 10Gbit/sec to each of the public universities and also interconnect them. A driver in this new-high-performance/bandwidth network is EthERNet's vision to provide a highly interconnected and advanced network of Ethiopian Research and Education institutions that enables institutions to actively and effectively participate in the national, regional and global research and education communities. The Ministry of Education is currently working with ICT Centre of Excellence (Ethiopia) to build a strong organisational framework for EthERNet that will enable it to engage with a wide range of stakeholders such as Universities, and involve them in helping set the direction and services that EthERNet develops and delivers.

Geographic Scope and frame: 22 Ethiopian public universities are connected

Funding source: Government of Ethiopia

6.3.2.2 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 UNDP.[38]

Around 756 schools are connected through this project. The second phase of SchoolNet project is ongoing to connect more schools and to provide internet access.

[38] https://www.cisco.com/web/about/ac79/docs/wp/Ethiopia_SS_0320a.pdf

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Geographic scope and frame: high schools, and preparatory Schools, total of 756+

Funding sources: Government of Ethiopia and UNDP

6.4 National ICT Research Capacity and Priorities for Cooperation

6.4.1 National Priorities

The country's research and development agenda focuses on incremental approaches and areas that are relevant for economic growth of Ethiopia 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 are already an important part of the power mix. So forecasting technology is used to mange 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
- **Natural Language Processing**
- **Indigenous Knowledge**

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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	25	939	20
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 an IST-Africa Stakeholder meeting with ICT stakeholders in Addis Ababa on 05 December 2013 and 19 November 2014 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**[39]

  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.

[39] http://aau.edu.et

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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 graduates 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**[40]

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.

- 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.

[40] http://amu.edu.et

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- **Jimma University**[41]

  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.

  - 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 Gondar**[42]

  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 undergraduate and 1,829 postgraduate students and provides 56 undergraduate and 64 postgraduate programs. Masters Programmes are provided in the areas of Computer Science, Information Science and Information Technology.

  - 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 University of Oslo since 2007 and a track record in FP7

- **Haramaya University**[43]

  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

[41] http://www.ju.edu.et/
[42] http://www.uog.edu.et/
[43] http://www.haramaya.edu.et/

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- Research areas include: Data Mining, Information Retrieval, Technology-enhanced Learning, Cyber Security

- **Mekelle University**[44]

  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 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

[44] http://www.mu.edu.et/

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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 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 clinic etc); indigenous knowledge system and Networks to support specific patient groups	Addis Ababa University (School of Information Science); Gondar University (Department of Health Informatics, Institute of Public Health; Dept. of Computer Science, School of Technology); Debre Birhan University (College of Computing); Jimma University
eAgriculture	Supporting pastoralists; Cloud Computing for Agricultural community	Arba Minch University (Department of Computer Science, Institute of Technology)
Natural Language Processing	Amharic - English eDictionary	Addis Ababa University (School of Information Science)

6.4.4 Mapping to H2020 Themes

The initial mapping to Horizon 2020 Research areas is summarised below:

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Horizon 2020 Industrial Leadership	Institution and Research area
Future Internet	**Addis Ababa University:** Wireless Computing, IP Networking **Arba Minch University:** Future Internet, Cloud Computing **Jimma University**: Internet of Things, IP & Mobile Networking **University of Gondar:** Wireless Networking
Content Technologies & Information Management	**Addis Ababa University:** Computational Linguistics & Language Technologies, Technology-enhanced Learning, Information Systems **Arba Minch University:** Big Data, Technology-enhanced Learning; Language Technologies **Jimma University**: Language Technologies **University of Gondar:** Languages architectures (programming), Information Retrieval **Haramaya University:** Data Mining, Information Retrieval, Technology-enhanced learning **ICT College of Excellence:** Localisation, Technology-enhanced Learning

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	**Addis Ababa University:** Health Informatics, eHealth **Jimma University**: Health Sciences **University of Gondar:** Health Informatics, eHealth
Food Security, Sustainable Agriculture	**University of Gondar:** Crop Production
Secure, Clean and Efficient Energy	**University of Gondar:** Sustainable Energy
Climate Action, Resource Efficiency and Raw Materials	**University of Gondar:** Water, Environment **Mekelle University:** Environment **HiLCoE:** Environment and Green Technology
Secure Societies	**Haramaya University:** Cyber Security **HiLCoE:** Information System Security

Level of Research Maturity

Ethiopia has a good research base and experience in 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. Some institutions have well developed Masters and PhD Programmes and are looking at collaborative research cross

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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.

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7. REPUBLIC OF KENYA

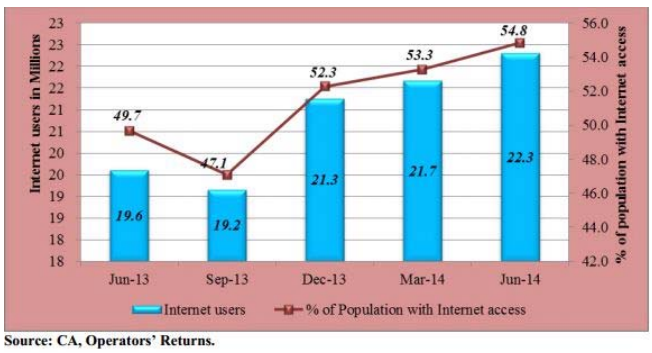
7.1 Introduction

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 2014 was estimated at 45 million inhabitants with a literacy rate of 87.4% (CIA World Factbook). The national population based on the 2009 census data (KNBS) was 38.4 million. 54.8 percent of the population is between 15 and 64 years of age. Nairobi, the capital city, has a population of 3.36 million (2011 - 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 four mobile operators in Kenya: Safaricom Ltd, Airtel Networks Kenya Ltd, Essar Telecom Kenya Ltd and Telekom Kenya Limited (Orange). According to Communication Authority of Kenya statistics, mobile penetration is at 79.2% as at June 2014[45], with 32.2 million subscriptions compared with 30.5 million in June 2013. Fixed lines have continued to decrease to 201,233 as at June 2014. Internet penetration increased to 54.8% with internet subscriptions increasing to 14

Source: CA, Operators' Returns,



Source: CA, Operators' Returns.

[45] CA Quarterly Sector Statistics Report, April - June 2014

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million in June 2014 compared with 12.4 million in June 2013

The ICT sector in Kenya has changed dramatically over the past decade transitioning to a burgeoning market. 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 Systems, and LION Optical Fibre Submarine Cable System). The expanded terrestrial fibre optic cable (5,500 kms) is complete and linked to the undersea cable. As a consequence the price of international connectivity has dropped from $7,500/month for 2Mbps to $650/month in 2011. The volume of communications has increased almost 300 times. 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. Since 2000, Kenya's economy grew at an average of 3.7 percent and it is estimated that without ICT, growth would have been only 2.8 percent and income per capita would have stagnated. The benefits of ICT are starting to be felt in other sectors: 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 22 fully chartered public Universities, 9 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: Kenya ICT Policy 2006 (under review), 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. Within the MTP for 2008 - 2012 one of the six priorities within the economic pillar includes Business Process off-shoring and Information Technology enabled Services. Within the social pillar, priorities include Education and Training and Labour and Employment (strengthening linkages between industry and training institutions). ICT is an important

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pillar of Vision 2030 to ensure connectivity for all to ICT services through communities, schools and hospitals.

During the first MTP, Kenya witnessed growth of key BPO companies such as Kencall, Safaricom, Kentech and Horizon. Growth was also witnessed in other related industries such as computer hardware manufacturing, software development, information and broadcasting, filming and digital content development. In the second MTP (2013 – 2017), the government's Goal over the planned period is to transform Kenya into a BPO/ITES hub for the East African region and beyond, building on the progress achieved to connect every Kenyan to the new infrastructure and harness ICT for efficient and effective government, e-commerce, economic growth and job creation for the youth. Flagship projects in this sector include completing the first phase of the Konza Technology City, capacity and skills development and local digital content development.

Vision 2030 Science, Technology and Innovation Sector plan (2013-2017) has 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 aims to set up three bodies under a Department for Science, Technology and Innovation:

1. Upgrade the National Council for Science and Technology to the National Commission for Science and Technology, which will consult stakeholders to determine STI priorities. It will be responsible for regulation and inspection of research facilities and programmes
2. Set up the Kenya National Innovation Agency, 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. Set up Kenya National Research Foundation 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. To date this has not been achieved. The National Innovation Agency and National Research Foundation have not yet been established.

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.

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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.

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 tele-centres 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 including the Laptop Programme, Digital Inclusion Projects (Pasha Centres/Digital Villages, Wezesha Initiative), Business Process Outsourcing, Local Content Programme (Tandaa Digital Content Grants, Open Data Portal), Information Security and Other Initiatives (Konza Technology Park, zero-rated taxes on imported ICT hardware, eGovernment, Skills Programmes).

7.3.1 Kenya Education Network (KENET)

KENET[46] 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

[46] http://kenet.or.ke/

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enacted in 2001. It is a not-for-profit Trust with seven registered Trustees (five Vice Chancellors, PS Education, DG CCK) and is governed by a Board of Trustees assisted by a Management Board. It has 86 full Members and is the largest NREN in Africa after TENET in South Africa. It is currently 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. There are 115 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 has a small infrastructure grant from Google and works 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 plans to launch an Internet Measurements Lab during 2013, which will be hosted by KENET. This will provide data and tools to support regulation.

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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 will be 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 fee 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 will now promote the use of official certificates by connected member institutions, not only for research but also for their ERPs and Cloud-based applications.

7.3.2 Digital Inclusion Projects

7.3.2.1 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 is to provide Internet access, e-government services and other e-services at the grassroots level via public-private partnerships.

7.3.2.2 Wezesha Initiative

The Wezesha ('to enable' in Swahili) Laptop Initiative ran from December 2010 to September 2011 to provide a subsidy towards purchasing a laptop for registered university students. This laptop initiative was funded by the World Bank and implemented by the Kenya ICT Authority under the

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Kenya Transparency and Communications Infrastructure Project (TCIP), as part of a component to implement the Computers for the Communities Initiative.

7.3.3 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.

7.3.4 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 of this, 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

Kenya was the first developing country to have an open government data portal, the first in sub-Saharan Africa and second on the continent after Morocco. The goal of opendata.go.ke is to make

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core government development, demographic, statistical and expenditure data available in a useful digital format for researchers, policymakers, ICT developers and the general public.

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

7.3.6.1 Konza Technology Park

As part of the Vision 2030 Flagship Programmes, the Government of Kenya through the Ministry of Information and Communication aims to set up a technology park at Konza. This project commenced in 2009 with the procurement of a 5,000 acre site, 60kms south east of Nairobi. The ground breaking ceremony was held by H.E. Mawi Kibaki on 23 January 2013. It is anticipated that the first phase of Konza City will create over 17,000 direct and indirect jobs. It is planned that the Tech city will host a BPO park, Science park, Convention centre, mega mall, hotels, international schools, world class hospitals, Championships Golf Course, Financial District, High Speed Mass Transportation and Integrated Infrastructure.

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.

A Cabinet Committee of participating Ministries responsible for Water, Energy, Power and Lands was put in place by H.E. the President to fast track the development of Phase 1 that runs from 2014 to 2018. The Government officially commissioned the Phase 1 infrastructure construction on 14 December 2014. The first phase will involve construction of BPO Park, Science Park, Residential Buildings, data Centre and part of Central business District. The legal notice on the establishment of Konza Technopolis Development Authority (KOTDA) and the board were gazetted and operationalised.

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,

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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 is currently holding negotiations 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 will also promote 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. It has since committed itself towards achieving an effective and operational e-Government to facilitate better and efficient delivery of information and services to the citizens, promote productivity among public servants, encourage participation of citizens in Government and empower all Kenyans.

Some of the key online services available through the e-government initiative include:

- Application of public service jobs online
- Tacking statutes of ID and passports
- Exam results and candidate selection
- Submission of tax returns
- Custom services
- Reporting of Corruption
- Business licensing e-registry

Other ongoing e-government projects include:

- Government shared services
- Government Data Centre
- Community Learning Information Centres
- County connectivity project
- Interactive Voice Response System
- Government unified messaging system

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- Capacity building

7.3.6.5 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. Nailab provides a 3 – 6 months entrepreneurship program, mentorship and facilities to support ICT start-ups. During 2014 two batches of ICT start-ups were incubated with a target to incubate at least 30 start-ups across Kenya by 2016.

7.3.6.6 Laptop Programmes for Primary Schools

The Government of Kenya plans to roll-out a laptop programme estimated to cost KES. 53 billion spread over the next three years. The programme will include infrastructure (energy, security and connectivity), devices, content and building capacity of teachers. The laptop programme will be enhancing integration of ICT into teaching and learning with the relevant content for every school age child. There are over 20,307 public primary schools with a total enrolment of 9.97 million learners and 1,378,622 expected to have joined standard one in January 2014. The current state of e-readiness status in Primary schools is poor, with a personal computer to pupil ratio of 1:1,000.

An institutional framework has been created to address ICT integration in education. Two specialised units have been created: the ICT for Education (ICT4E) to spearhead the pedagogical use of ICT, while the National ICT innovation and Integration Centre is to carry out the testing of technical solutions submitted for consideration by firms in order to establish their appropriateness and use in curriculum delivery.

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

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- 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		7,166	1,278

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			Computing and Informatics			
Multimedia University of Kenya	Nairobi	1,491	Faculty of computing and IT Faculty of Engineering		1,491	0
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 an 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		2,900	847

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			and Health			
University of Eastern Africa-Baraton	Nandi	2,200	School of science and Technology		2,065	135
KCA University	Nairobi	6,400	Faculty of Computing and Information Management	21	6,200	200

The following universities and research centres are currently involved in ICT research in Kenya

- **University of Nairobi**[47]
  - 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**[48]
  - 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**[49]
  - 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
- **Egerton University**[50]
  - Departments include: Faculty of Science, Faculty of Engineering & Technology

[47] http://www.uonbi.ac.ke/
[48] http://www.strathmore.edu/
[49] http://www.muk.ac.ke/
[50] http://www.egerton.ac.ke/

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- 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 University**[51]
  - Departments include: School of Engineering & Technology
  - Research areas include: Technology-enhanced Learning, Mobile Applications, eGovernment, Cloud Computing, Software & Services
- **Maseno University**[52]
  - 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 University**[53]
  - 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 University**[54]
  - 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 University**[55]
  - 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 Technology**[56]
  - Departments include: Civil Engineering & Geospatial Engineering, Electronic and Information Engineering

[51] http://www.ku.ac.ke/
[52] http://www.maseno.ac.ke/
[53] http://www.kemu.ac.ke/
[54] http://www.kca.ac.ke/
[55] http://www.usiu.ac.ke/
[56] http://www.jkuat.ac.ke/

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- 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)**[57]
  - Departments include: Faculty of Engineering & Technology
  - Research areas include: Mobile Applications, Parallel Computing / Cloud Computing, Software & Services
- **Technical University of Kenya (TUK)**[58]
  - 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 Kenya**[59]
  - Departments include: Faculty of Computing & IT, Faculty of Engineering
  - Research areas include: Communication Technologies
- **Dedan Kimathi University of Technology (DKUT)**[60]
  - 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 Technology**[61]
  - 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**[62]
  - Departments include: School of Information and Communication Technology; School of Engineering and Technology
  - Research areas include: Computing, Software and Services, Networks
- **Kenya Agriculture Research Institute**[63]
- **Kenya Medical Research Institute**[64]

[57] http://www.tum.ac.ke/
[58] http://www.tukenya.ac.ke/
[59] http://www.mmu.ac.ke/
[60] http://www.dkut.ac.ke/
[61] http://www.must.ac.ke/
[62] http://www.seku.ac.ke/
[63] http://www.kari.org/
[64] http://www.kemri.org/

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- 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 trails project funded by Bill & Melinda Gates Foundation in partnership with Hewlett Packard

7.4.3 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
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; USIS 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; USIS Africa (School of Business) ; University of Nairobi
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)

7.4.4 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	**Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT department, Telecommunication):** Smart Systems **KCA University (Faculty of Computing and Information Management):** Modelling of complex

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	systems **University of Nairobi (School of Computing):** Technologies for IoT, Modelling of complex systems **Strathmore University (@iLabAfrica ICT Research and Innovation Centre):** Smart Embedded Components and Systems, Smart Integrated Systems
Advanced Computing	**University of Nairobi (School of Computing):** Processor and System Architecture, Parallel Computing and Simulation Software **Strathmore University (@iLabAfrica ICT Research and Innovation Centre):** Processor and System Architecture, Interconnect and Data Localisation Technologies **Moi University (Department of Information Technology)**: Parallel Computing **Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT Department, Telecommunication):** Simulation and modelling **KCA University (Faculty of Computing and Information Management):** Simulation software
Future Internet	**KCA University (Faculty of Computing and Information Management):** Networks, cyber security **Strathmore University (@iLabAfrica ICT Research and Innovation Centre):** Networks, Software and Services, Cloud Computing, Cyber Security **Moi University (Department of Information Technology):** Software and services, cloud Computing **University of Nairobi (School of Computing):** Software and services, cloud computing, Cyber Security, Privacy and Trust, Wireless Communication **KENET:** Networks, Future Internet, Cloud Computing **United States International University**
Content Technologies & Information Management	**Moi University (Department of Information Technology):** Advanced data mining and Machine Learning **Strathmore University (@iLabAfrica ICT Research and Innovation Centre):** Machine Learning; Content Access and Analytics; Big Data Technologies; Advanced Data Mining **University of Nairobi (School of Computing)** Machine Learning; Content Access and Analytics; Big Data Technologies; Advanced Data Mining **KCA University (Faculty of Computing and Information Management):** Content Technologies and Information Management

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Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	**University of Nairobi (School of Computing/Medical School):** eHealth, improved diagnosis, healthcare provision **Jomo Kenyatta University of Agriculture and Technology (JKUAT) (Department of Computing, IT Department, Telecommunication):** eHealth, improved diagnosis **Strathmore University (@iLabAfrica ICT Research and Innovation Centre):** health data collection, Healthcare Provision and Integrated Care **Moi University (Department of Information Technology):** eHealth, Independent and assisted living, integrated health care **Kenya Medical Research Institute:** Screening and management of diseases; Integrated health care **USIS Africa (School of Science and Technology):** eHealth models, Early warning systems
Food Security, Sustainable Agriculture	**Moi University (Department of Information Technology):** Sustainable agriculture and Environment **University of Nairobi:** Food Security, Sustainable Agriculture, Bio-Economy **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 **Strathmore University (@iLabAfrica ICT Research and Innovation Centre):** Sustainable Agriculture and Forestry; Sustainable and Competitive Agri-food Sector for a Safe and Healthy Diet. **USIS Africa (School of Business):** Agri-business and Entrepreneurship **Kenya Agricultural and Livestock Research Organisation**
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.

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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

Level of Research Maturity

Kenya has a vibrant research community and good track record in collaborative research with participation in over **68 projects** and securing research funding of more than **€ 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.

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.

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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 2014 was estimated to be 1.942 million[65] with a literacy rate of 89.6%. Sixty one percent of the population is between 15 and 64 years of age (median 23 years). Maseru, the capital city, has a population of 239,000 (2011 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 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 is established to support research and research capacity development. The Communications Act 2012 became operational in April 2012.

In relation to Communications, according to 31 March 2013 there were 50,290 fixed phone lines in use compared with 1.581 million mobile phones. Internet uptake has been hindered by high bandwidth costs and slow and unreliable connectivity. Overtime this should change as Lesotho now has access to high speed international bandwidth through EASSy. While there has been an increase in Internet cafes they are primarily in urban areas with 40% in Maseru. There has been a gradual increase in mobile broadband usage. 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. The use of smartphones and other mobile devices has made the rollout of 7.2Mbs 3G coverage a mandatory development route for both operators.

In terms of ICT Infrastructure, Lesotho is a participant in the Eastern Africa Submarine Cable System (EASSy) through a Special Purpose Vehicle (SPV), the West Indian Ocean Cable Company

[65] CIA Factbook

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(WIOCC). The cable went live in July 2010 and places Lesotho at a position to have direct access to high-speed bandwidth for broadband services, which can support an increase in GDP, productivity, and employment growth. While this development supports the transformation into an information economy, broadband remains expensive and limited to a small number of people.

As part of the Universal Access Fund, the Lesotho Communications Authority (LCA) is supporting the establishment of the Internet Exchange Point in Lesotho (LIXP). Since the creation of LIXP, LCA is in a position to ensure that all internal Internet traffic is 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. Work has started to refurbish the data centre space for the LIXP in Maseru. The data centre will host the LIXP facilities and the infrastructure for the management of the country Top-level domain (.ls).

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 Government of Lesotho in its endeavour to develop an ICT-based Information Society has put a National Strategic Development Plan in place for 2013 - 2017. 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 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

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- eGovernment
- eCommerce
- Health
- Agriculture and Food Security
- Tourism, Environment and Natural Resources
- Gender and Youth

In 2009, the Universal Access Fund was established as a contributory partnership between Lesotho Communications Authority (LCA), Government of Lesotho and the two network operators, Econet Telecom Lesotho (ETL) and Vodacom Lesotho (VCL). The fund has made progress in extending the communications infrastructure in previously under served rural areas, which were seen as non-viable by the network operators. To date the Fund has completed seventeen GSM network infrastructure projects comprising of twenty four Base Transceiver Stations - eleven awarded to VCL and six to ETL. The seventeen projects cost in the region of M70 million and the Fund allocated c.M49 million as subsidies.

The proposed regulatory framework encourages the deployment of converged technologies, which can be offered over existing networks using IP technology.

In relation to overall infrastructure, the country intends to adopt 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 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:

1.1 The establishment of the Universal Service Fund and thus addressing more areas of communications other than just access;

1.2 The introduction of co-regulation and self-regulation within the broadcasting industry through the establishment of the Broadcasting Dispute Resolution Panel (BDRP);

1.3 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;

1.4 The introduction of regulation of Postal Services by LCA. When regulated, postal services would develop faster than at the present moment.

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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.

8.3.1 eLearning / Technology-Enhanced Learning

Despite its poor ICT infrastructure and high levels of poverty, Lesotho has begun to take the necessary steps to promote higher levels of ICT access and usage in its communities and education institutions. The National ICT Policy makes references to the education sector. Two key projects in the school sector are the NEPAD eSchools Demo Project and SchoolNet Lesotho. Which have highlighted how the use of ICT can enhance education. 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.

8.3.1.1 NEPAD eSchools Demo Project

The New Partnership for Africa's Development (NEPAD) eSchools Initiative is a multi-country, multi-stakeholder, continental initiative that aims to impart ICT skills to young Africans in primary and secondary schools and improve the provision of education in schools through ICT applications and the use of the Internet.

The first phase of the initiative was a demonstration project implemented by the private sector partners. The objectives of the Demo Project were to:

- Determine typical e-school scenarios and requirements in various circumstances in Africa
- Highlight the challenges inherent in a large-scale implementation of the e-school programme
- Monitor the effectiveness of multi-country, multi-stakeholder partnerships
- Determine best practice and exemplary working models for the large-scale implementation of the initiative, which aims to equip more than 550,000 African schools with ICTs and connect them to the Internet
- Demonstrate the costs, benefits, appropriateness, and challenges of a satellite-based network
- Demonstrate the costs, benefits, and challenges of ICT use in African schools

Lesotho is one of the 16 countries where the Demo Project was co-ordinated by a dedicated country liaison person based at the Ministry of Education and Training. Oracle and Microsoft supported the Demo Project in six Lesotho high schools by fitting each school with a lab comprising approximately 20 PCs, a server and printer, and a media lab which in some instances included a PC-based kiosk

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containing health information and satellite television access to education channels. Teachers at the six schools received training and learners have subsequently used the PC labs in the classroom.

Funding sources: Private sector partners

Geographic scope and time frame: National; ongoing

The SchoolNet Lesotho project has phased out and the schools continue to use the computers.

8.3.1.2 Pan African eNetwork – Tele-Education

This project aims at providing tele-education services to 10,000 African students to undertake Post-Graduate, Under-Graduate, PG Diploma and Diploma and skill enabling certification courses in subjects such as Business Administration, IT, International Business, Tourism and Finance over a 5-year period in Indian Universities/Educational Institutions.

The National University of Lesotho through its outreach programme Institute of Extra-Mural Studies (IEMS) is connected to Universities in India where students in Lesotho have access to lectures in Indian universities. There have been regular tele-education services.

Funding source: Government of India

Geographic scope and time frame: National; ongoing

8.3.1.3 Promoting Learning and Teaching through ICTs in Schools (Microsoft Multipoint Server)

This project aims to provide learners with access to ICT in challenging environments where there is a lack of electricity and computers in schools. It was initiated by a primary school teacher at 'Mamoeketsi Primary School in Lesotho as part of their endangered indigenous plants project. Learners were to collect indigenous plants at home and using parents' mobile phones, text the teacher images and observations about the plants to build a database at school.

The project came to the attention of Microsoft and Dell. Mamoeketsi Primary School was provided with a Microsoft MultiPoint server (as central control point for student desktops) and computers for learners. The teacher is able to tailor her teaching to each child's individual ability and can monitor each child's progress from one central point. The learners are also taught how to upload their own blogs as part of the learning experience.

Other teachers at Mamoeketsi Primary School have followed her example and classes are now arranged in a different setting altogether for almost every subject. The teacher is now helping train other teachers in Maseru and also going into the rural areas to show them how to use the software.

Funding source: Microsoft

Geographic scope: National; ongoing

8.3.1.4 Lesotho School Technology Innovation Centre (STIC)

STIC is a joint venture between Microsoft, the Government of Lesotho and other non-governmental partners, headquartered at the Lesotho College of Education (LCE) in Maseru. It is focused on the

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development and research of new educational approaches, classroom solutions and practice to improve 21st century education and skills development outcomes in Lesotho. To date, 14 LCE lecturers and over 900 local teachers have received teacher development training through the Microsoft Partners in Learning programme. It is envisaged that in the future training sessions will also be undertaken with school principals.

The centre provides quality ICTs for use in education and aims to support teachers to use ICT solutions to effectively deliver curriculum and other relevant learning materials, processes and pedagogies. The STIC provides a service to all higher learning institutions in Lesotho and also supports professional development of pre and in-service teachers.

Funding: Microsoft, through SchoolNet SA

Geographical Scope and time frame: 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

8.3.1.6 National University of Lesotho THUTO

The National University of Lesotho has implemented a Learning and Collaborative Environment called THUTO to facilitate course management (lecture notes, tests, quizzes and grades), forums and chat rooms for students and teachers to discuss course related issues. THUTO incorporates tools for administration, assessment, communication, resource sharing and collaborative learning. Staff members have been trained on available functionality.

Funding: University of Lesotho

Geographical scope and time frame: National; ongoing

8.3.1.7 Laptops to Lesotho Project (L2L)

The Laptops to Lesotho project is focused on raising funds to distribute OLPC XO laptops to children in rural Lesotho, provide training, establish a LAN network to facilitate internet access and translate materials into Sesotho. The L2L organisation is currently supporting 2 schools, by providing 86 XO laptops, a generator system and associated training on usage, maintenance, repair of the laptops and setting up the solar panels and using the generator. The solar panel in the school is used to charge cell phones to help raise funds for the project, supplemented by a fund raising

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concert per semester. The teachers have access to tools to support their math curriculum. The project aims to expand to a third school during 2016.

8.3.2 eHealth

8.3.2.1 ICT village in Mahobong

This project was intended to provide training on the use of ultrasound technology to the health personnel of the Holy Trinity Clinic in Mahobong to prevent deaths of mothers and children in the area surrounding the clinic.

A training period was initially undertaken in early 2011 and trained 20 people. OCCAM, WINFOCUS and Hospital of Lodi invited representatives from surrounding clinics to attend. A satellite connectivity was put in place initially to facilitate personnel in Mahobong to refer to dedicated staff at the Hospital in Lodi for second opinion and any other support needed.

While training was undertaken at St Joseph's Hospital, an ultrasound was not provided. Over time it was necessary for the Holy Trinity Clinic in Mahobong to lend their ultrasound to the hospital.

The project was phased out as no follow on funding was available to support ongoing activities.

Funding source: The Ministry of Health of Regione Lombardia – Italy

Geographic scope: Mahobong, Leribe District; project completed

8.3.2.2 Electronic Medical Record

Electronic Medical Record (EMR), which is a computerized medical record, is created in a few hospitals in Lesotho and as of 2011 none of them had a fully integrated system. Subsequently EMR will be created in all hospitals in Lesotho.

EMR systems will assist health care professionals to store and share patient information across disciplines and across facilities. It will also provide timely and efficient access to medical records without compromising patient privacy, and allows patients to engage in their own health care.

Funding source: Millennium Challenge Account (MCA)

Geographic scope and time frame: National and ongoing

8.3.2.3 Development of a web-based Social Welfare Routine Information System (SWRIS)

The Ministry of Health and Social Welfare of Lesotho (MOHSW) and specifically the Department of Social Welfare (DSW) developed a routine information system for Social Welfare as part of setting up a functional Monitoring and Evaluation system for the Orphans and Vulnerable Children (OVC) response in Lesotho. The system consists of a data procedure manual for data collection and reporting tools on services provided to OVCs at all levels. The frequency of data collection and reporting varies from monthly, quarterly and annually depending on the indicators for which data is collected and reported for purposes of Monitoring and Evaluation of the National OVC Program.

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There are an estimated 220,000 OVCs and scores of other vulnerable children. Some require basic services to enable them to lead near normal lives. In order to plan appropriately for these numbers of disadvantaged children, there is need to know those that are receiving services and those that are not. This can be best facilitated by developing a database on individuals receiving services and the type of services they receive. In addition, there are destitute adults and elderly people being provided with services and these too need to be captured.

DSW is in the process of designing, developing and adequately testing a web-based database application that will enable it to collect and report relevant information for decision making and service provision at all levels of its structure in responding to HIV and AIDS pandemic as per the MOHSW and DSW strategic plans.

Funding source: The Global Fund Coordinating Unit - Lesotho

Geographical scope and timeframe: National and ongoing

8.3.2.4 Laboratory Information System

The Association of Public Health Laboratories (APHL) through a cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC), Global AIDS Program (GAP) supported the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) by implementing a Laboratory Information System (LIS). The goal of this class of software, which handles receiving, processing and storing information generated by medical laboratory processes is to strengthen health system capacity and services for HIV/AIDS.

Lesotho piloted its current LIS in four laboratories (Central, Mafeteng, Makoanyane and Scott) after having assessed five of them.

There is a Health Management Information System underway which will include a central data repository serving health centers, hospitals, district health management teams, and central levels, where all health data can be stored and accessed. The system will include a dashboard to extract integrated reports. Data quality will be assured by built-in computer tools and techniques to check the reliability and accuracy of the data.

Funding Source: PEPFAR

Geographic scope and timeframe: National and ongoing

8.3.2.5 Rx Solution

From 2008 Strengthening Pharmaceutical Systems (SPS) has been providing technical support to the Ministry of Health and Social Welfare (MOHSW) by supporting the implementation of the Rx Solution, an electronic information management program. SPS is assisting the country to move towards a comprehensive, integrated patient management information system at hospital level. As at January 2012, Berea hospital has fully implemented the system, and now patient information can be tracked right from when the patient registers up until the dispensing point. This is a great milestone as it will assist the GOL in its endeavour to appropriately manage patient information,

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particularly of patients on ART, thus creating an enabling environment for improved management of patients on ART.

Funding Source: USAID

Geographic scope and timeframe: National and ongoing

8.3.2.6 Pan African Network - Telemedicine

The tele-medicine facility, which is focused on training the nurses and doctors on daily basis, will connect the Ministry of Health with health facilities around the world, while another system will be connected to the State House to enable the Prime Minister to communicate with other Heads of State. By January 2012 the infrastructure (satellite) has been installed in Teyateyaneng (T.Y.) Hospital.

Funding source: Government of India and African Union

Geographic scope and timeframe: National and ongoing

8.3.4 eGovernment

8.3.4.1 Digital Broadcasting Migration

The process is focused on migrating television broadcasting from analogue to a more spectrum-efficient and high quality digital platform by 2015. The Ministry of Communications, Science and Technology has invested M400 million into the project and it is in the first stage of implementation.

The adoption of digital broadcasting will enable consumers to benefit from improved reception quality, additional programme channels and more efficient use of spectrum in the country.

As a member of the International Telecommunication Union (ITU), Lesotho had undertaken to switch over from analogue television broadcasting to digital terrestrial television broadcasting by the middle of 2015.

The Ministry of Communications, Science and Technology setup a digital migration unit to take charge of the migration process supported by the advisory committee. Currently the Ministry has made some progress towards ensuring smooth operation from analogue to digital broadcasting, this includes the official launching of the project in February 2014 and the second draft of Lesotho Digital Migration Policy (March 2014).

Funding source: Government of Lesotho

Geographic scope and timeframe: National and ongoing.

8.3.4.2 Lesotho Government Data Network (LGND)

This project is 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.

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The main objectives are 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

8.3.4.3 Revamping of LGDN

This project run by the Department of ICT aims to upgrade the concentrator resources for the LGDN project in order to correct the problems arising from the core. This will enable smooth operation of LGDN project. This project aims to start in 2014.

Source of funding: Lesotho Government

Geographic scope and time frame: National and to be started in 2014

8.3.4.4 Establishment of IXP

The Lesotho Communications Authority (LCA) initiated the establishment of the Internet Exchange Point (IXP) in Lesotho in order to improve access speeds for Internet users, reduce cost since a good proportion of traffic would be exchanged utilising local rather than international bandwidth. In addition, the IXP would create revenue through new business opportunities by allowing easier hosting of local domains and improved access speeds. To this end, the Universal Access Fund (UAFC) set aside about M1.8 million towards the establishment of the IX.

Since the creation of LIXP, LCA is in a position to ensure that all internal Internet traffic is 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. Work has started to refurbish the data centre space for the LIXP in Maseru. The data centre will host the LIXP facilities and the infrastructure for the management of the country Top-level domain (.ls).

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Source of funding: Universal Access Fund

Geographic scope and timeframe: National and ongoing

8.3.4.5 Utilities Sector Reform Project

This project, which is implemented by The Ministry of Finance and Development Planning, addresses the infrastructure constraint in the implementation of Government of Lesotho's ongoing private sector led development strategy. Specifically, the project was to seek to improve business infrastructure such as electricity and telecommunication services, including provisions for Internet connectivity in the future.

Source of funding: African Development Bank, European Commission

Geographic scope and timeframe: National, final stage

8.3.4.6 Broadband Policy Project

This project running under the Department of ICT aims to formulate a Broadband policy that will enable more accessibility/penetration. The project started in 2014 and the second draft of the policy is now in place.

Source of funding: ITU and Lesotho Government

Geographic scope and timeframe: Nation wide; ongoing (5 year period)

8.3.4.7 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

8.3.4.8 Cyber Security Project

This 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:

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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. A national CIRT would become the focal point for coordinating information flow, respond to cyber-attacks and offer solutions to Cyber security incidents for the whole of Lesotho.

Funding: ITU through HIPSSA project "Support for Harmonization of ICT Policies in Sub-Saharan Africa"

Geographical scope and time frame: National and ongoing until 2016

8.3.4.9 eGovernance Infrastructure Project

The project 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 and improve access to e-services 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: Revamp core optic network and broadband access: optimise the metropolitan core fibre and addition of core fibre from the two datacentres in Maseru to Mohaleshoek where there will be a third data centre. This will be achieved through assistance by the Lesotho Electricity Company (LEC). In the case of broadband access, 4 unserved areas have already been selected and this in particular will be funded by Universal Access Fund.

2. Government ePortal: Architect and design the eGovernment portal commencing with 7 online services.

3. Skills Development: Facilities for training and research: Negotiations have been made that the facility training laboratory be placed at The Lerotholi Polytechnic where there will also be professional capacity building programs.

4. Strengthening data centres: Upgrading equipment and improving control in the data.

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Funding: African Development Bank and Universal Access Fund

Geographic scope and timeframe: National; started in 2014 and will run to 2017

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)	▪ 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)	▪ 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)	▪ Developing mesh networks for rural areas ▪ Convergence of analogue and data networks
Paying attention to the special needs of marginalized groups of society, including	▪ Speech recognition and text-to-speech for the visually impaired and the elderly for

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women, youth, the disabled, disenfranchised and the elderly. (2.2.6)	government services access. ▪ 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)	▪ Software development cost reduction through use of FLOSS
Improve internet access for tourists throughout the country	▪ 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)	▪ 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	▪ 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	▪ 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	▪ Optimization of Communication networks

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the country (IEMS can benefit from this objective)	for enabling distance e-learning
Use of mobile devices for teaching	▪ 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)	▪ Development of interactive web services and WAP services
Online payments for electricity, water and gas	▪ Development of interactive web services and WAP services
Promote the development and dissemination of local ICT products and services (2.1.5)	▪ 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)	▪ Development of Mobile Commerce Applications

Research Priority: Network Technologies

Research Objectives	Research Areas
Develop network technologies suitable for government service delivery in Lesotho	▪ 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	▪ 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**[66]
  - Dept of Mathematics and Computer Science

The Department of Mathematics and Computer Science in the National University of Lesotho has a Computer Unit (CS Unit), which is responsible for research in ICT. 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) and (c) Information Systems (IS). 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

[66] http://www.nul.ls/

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- 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.

- **Lesotho College of Education**
  - Depts include: Dept of Information Technology, Dept of Computer Science
  - 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 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 Technology; 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 Technology
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 Technology; Lesotho Agricultural College; Department of Agricultural Research (MoAFS)
eGovernment	Public service delivery; Online application for student loans	National University of Lesotho; Limkokwing University of Technology; MCST - Department of ICT

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8.4.4 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 & Systems	**Limkokwing University of 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 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 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

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	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 Technology (Faculty of Information and Communication Technology)**: eLearning
Secure Societies	**Limkokwing University of Technology (Faculty of Information and Communication Technology)**: 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.

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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 17.3 million (July 2014 CIA World FactBook) with an average yearly growth of around 3.2 % and a GDP per Capita of 900 USD. Fifty percent of the population are between 15 - 64 years of age, with a literacy rate of 74.8%. 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 772,000 (2011). 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 2012 figures (CIA World Factbook), there were 227,300 fixed phone lines in use compared with 4.42 million mobile phones. There were 1,099 Internet hosts (2012) and 716,400 Internet users (2009).

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. 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.

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There are thirteen institutions of Higher Education: 3 public Universities (University of Malawi, Mzuzu University and Malawi University of Science and Technology), 7 public Polytechnics and specialised Colleges and 4 private Colleges.

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 assume the regulatory functions of the communications sector, which had been performed by the Malawi Telecommunications Corporation Limited. The Communications Act has universal access, rural connectivity, liberalization, and private sector involvement as key objectives.

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 exists 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.

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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. The plan is yet to be approved by the Government Its overall objective is to implement the ICT policy. The plan spans the years 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 and the second one runs from 2011 to 2016.

Within the MGDS, ICT and telecommunications fall under the theme of infrastructure development and good governance whose long-term goal is to have a well-developed, affordable and efficient telecommunications system accessible to those who need it. Key strategies for achieving this include: developing a system that is conducive to business operations; and enacting appropriate legislation that promotes interest of new entrants.

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.

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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.

9.3 Current ICT initiatives and projects

ICT Initiatives are currently ongoing at national level in the area of eGovernment (eGovernment Programme, Electronic Legislation), 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 and eBanking.

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

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- 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 will implement 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 (MalTIS) 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

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(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. A draft Bill is currently in place.

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 Data Protection Bill component provides security for electronically formatted, personal information. A draft Bill is finalized awaiting its review and cabinet approval.

Source of funding: World Bank

Geographic scope and timeframe: National, to be enacted from 2013, ongoing

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

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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 is provided for five years as part of the project.

Expansion Plans

Over the initial five year period Chancellor College of University of Malawi has demonstrated that eLearning is possible if managed well. There are plans that Chancellor College should now be graduated into an Institution that could be providing its own programmes in form of tele-education to prospective students in cities and other regions in Malawi. The studio to cater for this is being set up at Chancellor College. The next steps will be setting up of eLearning centres in Malawi regional cities. Chancellor College is ambitious and wises to offer the same to the SADC region, with the experience and lessons learnt from the Pan African eNetwork. Conceptualisation is at an advanced stage.

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

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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.

A consultant (SimbaNET) was engaged to look at how Internet capacity can be made more affordable and available. It was planned that this would be realised in 2014 by the commissioning of a Virtual Landing Point (VLP) in Lilongwe which will be connected to two redundant routes, one through the northern corridor to Tanzania and another one through Mchinji boarder to Zambia.

Monitoring and evaluation was undertaken during 2014 to determine if the third phase has started to bear fruits in the targeted institutions.

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)

This 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

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9.3.6 MACRA Infrastructures Projects

MMalawi 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. This will help in the attainment of the Millennium Development Goals (MDGs) as people will have 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.

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.

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.

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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 two year strategic plan from 2013 -2015 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)**.**

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MAREN was registered as a not-for-profit company limited by guarantee in late 2009. 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 Blanytre 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.

In order to implement the regional high capacity data network for research and education in Eastern and Southern Africa, the EU funded AfricaConnect Project was launched in May 2011 and is being implemented by UbuntuNet Alliance for the benefit of its members throughout the region. When in place, this network will facilitate the participation of Malawi educators and researchers in regional and global collaborative teams and bring the learning and research experience much nearer with the institutions in the West. Among the outcomes will be:

- E-Medicine
- High definition video conferencing
- Enhanced e-learning
- Participation in global virtual research communities.

The National Commission for Science and Technology, University of Malawi and Mzuzu University are represented on the board of Directors.

Source of funding: UbuntuNet Alliance, MAREN members

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.

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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.

Source of funding: Malawi Government through ESCOM

Geographic scope and timeframe: National, 2008-2011

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

Geographic scope and timeframe: National, 2009- current

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9.3.11 eHealth Projects

Baobab Health Trust, a Malawian NGO focused on providing technology solutions for healthcare challenges in Malawi, works with the Ministry of Health to design and utilise medical informatics to replace traditional paper based systems. Solutions assist healthcare workers with registering patients and aggregating essential medical data for improved healthcare management to facilitate efficient patient care. Projects include setting up a 24 hour toll free hotline, accessed by clients seeking health advice about their pregnancy or care of young children and a booking systems for ante and post natal care using SMS Technology.

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.

In addition there is the Health Management Information Systems (HMIS), developed on Windows using simple programming language on a common desktop database platform using MS Access with district level systems on standalone platforms. There are plans to use web based DHIS2 version by modifying the open source code for District Data with support from Oslo University and Malawi College of Medicine. The system was developed with support of Technical Assistance through donor financial aid. The Malawi government sustains the day to day running of the system.

Source of funding: Malawi Government, University of Oslo, Michigan State University

Geographic scope and timeframe: National, 2009- current

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.

Banks are using ICT to provide Internet banking to its clients. 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 main goal is to introduce Active Digital Television signal in Malawi and with a target of smooth migration from analogue to Digital Terrestrial Television Broadcasting. It is an ITU driven project and Malawi is the signatory to the ITU June 17, 2015 Migration Agreement.

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The Malawi Digital Broadcasting Policy was approved by Government in July 2013. The network was commission on 31st December 2013. The project aspires to reach out to 90 % of the Malawian Population. The network is expected to carry 20 TV channels and 10 Radio channels, but currently there are only 9 TV channels on the network.

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.

9.4 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

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- 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; East of 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	

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

- University of Malawi - Chancellor College[67]
  - 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
- University of Malawi: Polytechnic[68], Engineering Department
  - Research Focus - Use of ICT in Science and Engineering, internet research and security, software development, Geographic Information Systems- remote sensing, Environmental health
- Mzuzu University[69] - ICT and Informatics Department

[67] http://www.chanco.unima.mw/
[68] http://www.poly.ac.mw

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- 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

9.4.3 ICT-39 Priority Themes

Based on consultation with stakeholders and discussion during the IST-Africa H2020 Workshop on 12 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; 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
eAgriculture	Food Security; Agri-food based applications; Market Information; Aflatoxin management in food crops	LUANAR; Chancellor College; Department of Agriculture Research
Technology-enhanced Learning	mLearning; Distance Learning	LUANAR; Chancellor College; Mzuzu University; National Library Services
Environment	Renewable Energy; Waste Management including eWaste	LUANAR; Malawi University of Science and Technology (Climate and Earth Science Dept); University of Malawi (Chemistry Dept)
eGovernment	Public Service Delivery; eCommerce Applications	Chancellor College, Polytechnic; eGovernment Dept.

9.4.4 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	**Chancellor College, University of Malawi (Dept of Computer Sciences):** Smart Embedded Components and Systems, Organic Electronics, Large Area Integration, Smart Integrated Systems, Systems of

[69] http://www.mzuni.ac.mw

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	Systems and Complex System Engineering **University of Malawi - The Polytechnic (Department of Computing and Information Technology):** Smart Embedded Components and Systems, Organic Electronics, Large Area Integration, Systems of Systems and Complex System Engineering **National College of Information Technology**: Smart Embedded Components and Systems **College of Medicine, University of Malawi:** Smart Embedded Components and Systems, Organic Electronics, Smart Integrated Systems
Advanced Computing	**Chancellor College, University of Malawi (Dept of Computer Sciences):** Interconnect and Data Localisation Technologies, Cloud Computing, Parallel Computing and Simulation Software **University of Malawi - The Polytechnic (Department of Computing and Information Technology):** Interconnect and Data Localisation Technologies, Cloud Computing, Parallel Computing and Simulation Software **Mzuzu University (Department of Information, Sciences and Communication):** Interconnect and Data Localisation Technologies, Cloud Computing
Future Internet	**Chancellor College, University of Malawi (Dept of Computer Sciences):** Cloud Computing, White Spaces, Networks, Software and Services, Wireless Communication **University of Malawi - The Polytechnic (Department of Computing and Information Technology):** Cloud Computing, Networks, Software and Services, Wireless Communication, Immersive Interactive Multimedia **Mzuzu University (Department of Information, Sciences and Communication):** Cloud Computing, Networks, Software and Service
Content Technologies & Information Management	**Chancellor College, University of Malawi (Dept of Computer Sciences):** ICT Infrastructure, Language Technologies, Digital Repositories, Digital Preservation, Technology-enhanced Learning, Machine Learning **University of Malawi - The Polytechnic (Department of Computing and Information Technology):** Advanced Data Mining, Technology-enhanced Learning **Mzuzu University (Department of Information, Sciences and Communication):** Digital Repositories, Technology-enhanced Learning, Analytics **Kamuzu College of Nursing (Community and Mental Health Dept):** Technology-enhanced Learning

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Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	**College of Medicine, University of Malawi:** Telemedicine **Kamuzu College of Nursing (Community and Mental Health Dept):** Telemedicine **Mzuzu University (Dept. of Health Sciences; Department of Nursing and Midwifery and ICT Dept):** Health Information Systems. eHealth **Chancellor College (ICT Dept.):** Mobile applications in e-health **Polytechnic (Dept. of Environment):** Environmental health, health information system
Food Security, Sustainable Agriculture	**LUANAR (Dept. of Crop and Soil Sciences, Dept. of Home Economics and Human Nutrition, Dept. of NRM)** **Mzuzu University**: Sustainable Food Production Systems **Lilongwe University of Agriculture & Natural Resources**: Sustainable Food Production Systems **Department of Agricultural Research Services**: Sustainable Food Production Systems
Climate Action, Environment, Environment, Resource Efficiency and Raw Materials	**Lilongwe University of Agriculture & Natural Resources**: Water Resource Management
Secure Societies	**Chancellor College, University of Malawi (Dept of Computer Sciences):** Trustworthy ICT **Polytechnic:** Trustworthy ICT

Up to November 2013 Malawi has been successful in securing participation in **20** FP7 projects in the following thematic areas: ICT (2 projects), INCO (1 project), Infrastructure (5 projects), Environment (2 projects), Health (8 projects), KBBE (1 project) and Science in Society (1 project). Up to September 2013, Malawi organisations had secured **€3.06 million** in funding under FP7.

Level of Research Maturity

Malawi has a good research base and experience in collaborative research with participation in over **20** projects and securing over **€3.06 million** in funding under FP7. Most of the research is being conducted at the public Universities as well as research institutions. The National Commission for Science and Technology is providing active support to the research community through IST-Africa activities.

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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.

A melting pot of the world's oldest civilisations, Mauritius is a rare example of social peace and unity in a multi-cultural society. The population boasts origins from the European and African continents, as well as India and China. Such a cosmopolitan legacy makes for legendary hospitality. Mauritius is a safe place to live, Mauritians being naturally well-inclined and of peaceful nature. All Mauritians enjoy freedom of expression and religion.

The population is estimated at 1.3 million inhabitants in 2013 with a literacy rate of 89.8% (Statistics Mauritius 2013). In 2012, nearly seventy percent of the total population was between 15 and 64 years of age. Port Louis, the capital, has a population of 128,000 (Statistics Mauritius 2013). The languages are Creole, Bhojpuri, French and English.

Mauritius has the highest adult literacy rate for the whole of Africa as a result of free education at primary and secondary school level. This highly disciplined and educated workforce is also equally fluent in English and French, while many also speak a third international language: Hindi, Mandarin, Urdu and a host of European languages. The workforce is young, 29.2% being aged less than 30 and business spirited, innovative thinking and open to the world.

Mauritius has a smart brand of fine professionals, most of whom qualified from internationally recognised institutions and/or world class professional bodies: chartered accountants, financial analysts, corporate lawyers, tax specialists, business consultants, IT engineers, architects. Recently, the Government of Mauritius enacted legislation encouraging foreign professionals to set up in the country.

Benefiting from a convenient time zone that makes same-day transactions possible from the US, through Europe, the Middle-East and Australasia, Mauritius is emerging as a major international business platform in this region of the world.

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The Mauritian economy is one of the fastest growing in sub-Saharan Africa. In just four decades, the country has moved from a mono-crop sugar-dominated economy to being services oriented. The tertiary sector currently accounts for 70% of GDP, which is an impressive track record. Although tourism and financial sectors are well anchored in its traditional economic setup, the ICT sector has recently been propelled into a major role as the third pillar of the Mauritian economy.

While endowed with a small, but increasingly affluent local population, Mauritius has secured preferential access to markets worth several hundreds of millions of consumers. Mauritius has agreements in place with the EU through the Cotonou agreement; with the US under the Africa Growth and Opportunity Act; with Eastern and Southern Africa, through the Common Market for Eastern and Southern Africa (COMESA) and Southern African Development Community (SADC).

In relation to Communications, according to 2013 figures, there were 356,500 fixed phone lines in use and 1.465 million mobile phones. There were 51,139 Internet hosts (2012) and 598,900 Internet subscribers (as at June 2013).

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.

The telecommunications sector was liberalised at the end of 2001 and has evolved from a classical analogue network to a fully digital one, endowed with enhanced capabilities in terms of bandwidth, connectivity and value-added services. In addition, since 2002, Mauritius has been well connected to the rest of the world via satellite and through the South Africa Far East (SAFE) submarine cable providing high bandwidth international connectivity. In 2009, the government launched the Lower Indian Ocean Network (LION) submarine fibre cable system, which links Madagascar, Mauritius and Reunion Island, is 1070 km in length and consists of 2 fibre pairs. This cable brings resiliency to the country's connections and makes it more attractive to investors. In 2011, the government launched the LION2 submarine cable (3,000 km in length), which extends the LION cable to Kenya via the island of Mayotte. The LION2 cable provides Mayotte, for the first time, with access to a broadband Internet network benefiting from a transmission capacity and service quality equivalent to those available in Europe. (Source Mauritius Telecom)

Within the public sector, there are seven tertiary education institutions namely 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, namely the Mauritius Institute of Training and Development (MITD), the Mauritius Institute of Health (MIH) and the Mauritius Institute of Education (MIE) also run programmes at the tertiary level. In

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addition to the ten institutions above, 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). A majority of the private institutions operate on a part-time basis in the evenings and during weekends, with relatively small student cohorts.

10.2 ICT Background

Mauritius has emerged as an international and competitive ICT destination and is steadily positioning itself as a regional ICT Hub. Over the recent years, the ICT sector has experienced a rapid and sustained growth and has become a strong pillar of the Mauritian economy. In 2002, the ICT sector represented 4% of the country's GDP as compared to 6.4% in 2013. In 2013, the growth rate in the ICT sector was 7.3% and value added generated by the ICT sector was MRU Rs 20.6 billion in revenue (Source: SM) (1 USD approx Mru Rs 30). An increasing number of foreign companies are nowadays setting up their bases in Mauritius to conduct ICT and ICT-related activities.

In line with its vision to transform Mauritius into a Cyber Island and make of ICT an important engine of economic growth, the Mauritian Government[70] has consolidated bases for a strong ICT sector and has launched the National ICT Strategic Plan (NICTSP) which includes 124 programmes to be implemented over the period 2007-2011. The vision and targets of the NICTSP are for the ICT sector to reach GDP contribution of 7% by 2011 from export of ICT services and employment of Mauritians in ICT increasing from 16,000 to 20,000. The National ICT Strategic Plan was reviewed in 2011 and a new strategy for the period 2011-2014 branded as "Towards i-Mauritius" has been developed, and is one of the three activities undertaken under the Competitiveness and Public Sector Efficiency (CPSE) program, which aims to sustain growth and employment, while helping Mauritius to address the impact of the global recession.

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.

The Ministry of Information and Communication Technology[71] has the following objectives:

- 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

[70] www.gov.mu
[71] http://www.gov.mu/portal/site/telcomit

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- 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
- Promote and facilitate IT Security within Government Systems

The Government Programme 2010 - 2015 is to create an “i-Mauritius”, Intelligent Mauritius, which is to make Mauritius one of the most connected nations in the world and also reduce the digital divide as "broadband" remains one of the ways to accelerate the integration of new technologies and allows citizens to take better advantage of ICT.

Some 600 ICT-BPO companies presently operate in Mauritius, in a wide range of activities including software development, call centre operations, business process outsourcing (BPO), IT-enabled services (ITES), web-enabled services, training, hardware assembly and sales, networking, consultancy, multimedia development, disaster recovery (DR) and other support services.

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.

ITES-BPO is a very strong segment of the Mauritian ICT industry and has been the fastest growing sector over the recent years, with over 330 companies mainly servicing export markets such as France, the USA, the UK, Belgium and other European countries.

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.

The Business Parks of Mauritius Ltd[72], a government-owned company, is responsible to spearhead the development, construction and management of state-of-the–art technology and hi-tech business parks in Mauritius. The BPML has set up the Ebène Cybercity, the first of its kind of a new generation of technology parks in this part of the world. The entire Cybercity, spread over an area of about 172 acres, is wired with fibre optic to provide high bandwidth international connectivity. The

[72] BPML - www.e-cybercity.mu

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main components of the Ebène Cybercity are the Cyber Tower 1, an intelligent 12-storey building of 42,274 square metres equipped with ultra modern features, and the Cyber Tower 2.

Mauritius is among the most competitive and successful economies in Africa. It holds the pole position for ease of doing business in Africa. The country is ranked at 10th position among 189 countries according to the World Bank's 2014 Doing Business Survey.

10.3 Current ICT Initiatives and projects

ICT Initatives are currently ongoing at national level in the areas of Education (Universal ICT Education Programme, Education through ICT, ICT Skills Development Programme), Digital Divide (Community Empowerment Programme, Public Internet Access Points, Cyber Caravan Project, Community Web Portal), eGovernment (Governement 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, eGoverment Stategy Report), Cyber Security (National Computer Emergency Response Team, Critical Inofrmation Infrastructure Framework, National Cyber Security Strategy), Entrepreneurship (NCB ICT Incubator Centre) and Green IT (National Green IT Policy and Strategy, eWaste Policy and Stategy, Open Source Policy and Strategy).

10.3.1 Universal ICT Education Programme

The National Computer Board operating under the aegis of the Ministry of Information and Communication Technology has been implementing the Prime Minister's 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 is of 45 hrs duration and trainings are done in state secondary colleges after school hours. To date some 178,000 people have already been trained on IC3.

10.3.2 Universal ICT Education Programme – Phase II

The National Computer Board has launched the UIEP Phase II whereby more than 3,000 online professional IT and non–IT courses are being made available at very interesting prices to all those who complete the IC3 or already have a recognised certificate in IT in January 2010. The courses modules are bundled into 15 separate packages and includes course materials leading to popular certifications such as MCSE, MCSA, MCAD, CISCO, CompTia, Oracle, A+, N+, Server+, Linux, Project Management etc.

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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 will contribute for the development of Mauritius in the following ways:

- Bring together the country's development stakeholders to build a strong online network of local, regional and global development communities on the web. Address the needs of various communities in Mauritius including NGOs, academic and private sectors and professionals.
- Democratise access to ICT.
- Provide comprehensive, high quality information about the country, its economic and social structure.
- Help to reduce the “Digital Divide” by providing concerned online information.
- Stimulate the development and production of local content on the Internet.

To date, 264 computer clubs with free Internet access have been set up in 23 youth centres, 17 women centres, 57 social welfare centres, 124 community centres, 20 day-care centres and 23 NGOs/Municipal Councils/Village Halls across the island. Around 1,116,281 people (including recurrent users) have been able to make use of the facilities. 8 Computer Clubs are remaining to be set up in 7 Community Centres and 1 NGO / Village Hall. A Community Web Portal will host contents of over 100 villages and localities online.

The Community Empowerment Programme has been extended to Rodrigues Island in collaboration with the National Empowerment Foundation (NEF) with the setting up of Learning Corners. 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.

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.

An additional 10 Learning Corners will be set up as from 04 August 2014 in Rodrigues with the collaboration of NEF and Mauritius Telecom Foundation.

10.3.4 Public Internet Access Points

One hundred Public Internet Access Points (PIAPs) have been set up in Post Offices (95 in Mauritius and 5 in Rodrigues) and around 194,670 people have been able to make use of the facilities. This service is provided free to disabled, orphans, senior citizens, unemployed and a nominal fee for other users.

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10.3.5 Cyber Caravan Project

Launched in November 2000, the Cyber Caravan Project aims at making IT facilities available to the community. The NCB presently operates three Cyber Caravans, which are equipped with 9, 10 and 21 PCs respectively and broadband Internet connection. Training on ICT Awareness and IC3 on a regional basis is provided on board the Cyber Caravan. To date, about 160,000 people have been initiated in basic IT Skills (2 hrs course) and IC3 (45 hrs course).

10.3.6 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 Portal[73] (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 especially the eFiling of income tax. 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.

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.

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.

10.3.7 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.

[73] www.gov.mu

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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
- 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)

10.3.8 NCB ICT Incubator Centre / Technopreneurship Programme

The NCB ICT Incubator Centre was set up to encourage young entrepreneurs to create start-ups in the ICT sector by providing them with logistic and business support. The NCB-ICT Incubator centre has benefited from financial assistance from the infoDev Capacity Building Grant – Support for new and start-up incubators in developing country in 2004.

The National Computer Board has revamped its ICT Incubator Centre to a Technopreneurship programme to encourage innovation and creativity to develop a community of Entrepreneurs in the ICT Sector. The NCB Provides Guidance, Business Advice, Support and Training to Start Ups under its Technopreneurship Programme.

To promote software development, the NCB is offering Microsoft BizSpark. BizSpark is a global program that helps software start-ups succeed by giving them access to current full-featured Microsoft development tools and technologies to build their applications, professional technical and community support and global visibility to an audience of potential investors, clients and partners. Microsoft and the US Embassy through the U.S. Global Entrepreneurship Program also supported the NCB for Capacity Building Programme namely Apps and Business plan writing.

The Technopreneurs of NCB are being guided to become world class Technopreneurs. In 2012, Archnet Ltd, one of our Technopreneurs was selected by the US Embassy to participate in the Young African Leaders Innovation Summit and Mentorship Programme in Washington DC, USA. In 2013, LittleBox Studio Ltd, another startup was nominated to participate in the East Africa Regional Startup Boot Camp in Dar es Salaam, Tanzania on May 7-8, 2013, as part of the Global Innovation

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through Science and Technology (GIST) Initiative. LittleBox Studio was ranked 40th out of 200 participants present at the event.

To attract the innovative minds of Mauritius new generation by challenging their creativity and capacity in Business, Science and Technology, the National Computer Board organised the ICT Business Idea Competition 2014, the first ever competition of its kind in Mauritius.

Regular sensitization campaign, workshops, conferences, etc are organized. To increase the ICT Adoption among SME's Workshop on "SMART SMEs: Empowering SMEs through ICT" was organized to trigger the importance of ICT adoption among non ICT SMEs.

The objectives of the SMART SMEs conference were to create greater awareness among SME's on the benefits of ICT in enhancing their competitiveness in the new Economy; to learn how ICT can best help SMEs to solve their business challenges for self-empowerment, greater efficiency and sustainable growth and to showcase and promote ICT products and services that is most applicable to the ICT development of SMEs.

10.3.9 Mauritius National Identity Card (MNIC)

A new system for national ID is the key foundation stone to the continued progress of Mauritius in the direction of digitalising and streamlining e-government services. In this context, the Government has developed a new ID card which offers citizens a new, high-security ID card, as well as a new population database, advanced security systems for ensuring and protecting citizen data and privacy. The new card incorporates state-of-the-art fingerprint biometric technology, and will eventually serve as an ID document that requires less paperwork to prove identity. With the new card and system, citizens will be able to enjoy more secure and reliable citizen-to-government transactions, as well as overall increased efficiency and shorter processing time in using government services.

10.3.10 Education through ICT

Several initiatives are under way to promote education through the use of ICT in the education sector. The government has embarked on an e-education plan, envisaging e-education projects such as the e-education portal and school administration systems. Likewise, the Government is implementing the Sankoré project, whose objective is to facilitate the provision of education to children through innovative technological means. It involves equipping all schools with low-cost digital interactive equipment (projectors and laptops) as well as providing educational software, thereby furnishing an infinite variety of pedagogical tools for both teachers and students. This will make the teaching/learning process more creative and lively and have a positive impact on the performance of pupils, thus contributing massively to improvement of their education.

The Government wishes to transform the manner in which educators teach students and how students learn from their peers through the introduction of ICT multimedia tools in the classroom.

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The Tablet PC project started in 2014 with the deployment of 26,100 tables to Form IV students and educators and will subsequently be deployed in Forms V and VI in the coming years. This will revolutionize the way education is being imparted.

In order to create a virtual community of online learners across the country, high speed secure internet links and wireless connectivity in schools will also be provided during 2014.

10.3.11 Public Key Infrastructure

To support the development of ecommerce, a Public Key Infrastructure (PKI) Ecosystem has been established in Mauritius. The National Computer Board (NCB) is partnering with eMudhra as its Local Agent in Mauritius to carry out the business of Digital Certificates Processing for individuals and organisations in Mauritius.

The Mauritius Post Limited (MPL) is acting as a Registration Authority (RA) for the issuance of Digital Signature Certificates.

10.3.12 ICT Skills Development Programme (ISDP)

The ICT Skills Development Programme was launched in October 2012 to address the mismatch of ICT Skills and to cater for the increasing demand of manpower in the ICT/BPO industry. It is estimated that the ICT Sector would require an additional workforce of 15,000 persons in the next few years.

The ICT Skills Development Programme comprises two incentive schemes for ICT/BPO companies. The Training and Work Placement Scheme encourages ICT-BPO companies to train unemployed youths having an SC, HSC, Diploma and/or Degree on an industry led Mauritius Qualification Authority (MQA) approved course and to offer them a placement. The scheme entitles ICT/BPO companies to claim the refund of up to 50% of stipend and 50% of training costs, where applicable.

The second scheme, the Work-Based Learning for University Students scheme, allows Employers to identify talents before graduation among Tertiary Level Students through a 'Work Based Learning' concept. ICT/BPO companies are encouraged to recruit trainees from the ISD Programme database and offer them a work-based training/placement. Trainees should undergo the training/ placement for at least 2 times for a period of 6 weeks each during a year of study. Participants receive an all-inclusive stipend during the placement. The scheme refunds 50% of the stipend paid to the ICT/BPO Company.

To date, c. 158 companies and 4,000 job-seekers have registered with the ISDP, out of which around 883 participants have secured training and work placement.

10.3.13 Community Web Portal

The Community Web Portal (CWP) is being developed with a view to encourage the development of local content and creativity. The CWP is a platform to facilitate the process for the community to

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make use of ICT to participate in the socio-economic development of the country. Its objectives are to:

- Encourage the development of local content and creativity
- Democratise access to information
- Promoting community development by enabling collaboration and knowledge sharing and facilitating communication.

The CWP provides local content for democratised information sharing with a web page for each location. The CWP covers the locations of Mauritius to provide information about the country; its geographic, historical, economic, social structure, relevant activities, businesses, etc.

So far, content for above 100 villages and localities of Mauritius have been gathered. Contents for the remaining locations of Mauritius are being gathered progressively.

10.3.14 E-Government Projects

Some of the main e-government projects that are currently being implemented are as follows: -

(a) The ***e-Judiciary*** **programme** has been initiated by the Ministry of Information and Communication Technology to upgrade the country's existing court management system, which dates back to 1994. The following systems have been implemented:

- System for follow-up of cases lodged till delivery of judgments and retrieval of past judgments by using Zyindex Text retrieval system
- Digital Court Recording System to recording and retrieve Court Hearings;
- Court Management System to support the activities of the Intermediate, Industrial and District Courts;
- Library system for accessing judgments and legislation through the internet.

In 2012, the Supreme Court reviewed its Court Management System with a view to deliver its services electronically by providing facilities to Attorneys for electronic submission and exchange of documents with the Judiciary.

(b) The ***Crime Occurrence Tracking System (COTS)*** is being implemented in phases. COTS Phase 1 will be used for close monitoring of crime occurrences. This will make crime statistics available in real time. The system will contribute towards an enhanced customer-centered service for peace, security and order in the entire country. COTS will cater for the end-to-end automation of all processes, from the electronic lodging of complaints at the police station to determination in a court of law, with the possibility of electronic tracking of intermediate phases. Data captured at police stations would be cross-checked and validated against other databases such as: passenger travel information, vehicle information database and citizen details. COTS has been piloted at two Police Divisions. The system will now be deployed at the other five Police Divisions.

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(c) **The *E-Payment* project aims at facilitating transactions** made at government counters and to encourage the adoption of government e-services. The e-payment system will support payment by credit/debit cards with a view to reducing time spent to make payments. The Generic E-Payment system is operational as from November 2013 on the new platform of the Government Online Centre. Several e-payment services such as the payment for Driving license and police fees, for Lease of state land, for Incorporation of a business, company registration fees and parking fines are now operational.

(d) The Ministry of Health and Quality of Life has developed a complete strategic framework for the adoption of eHealth in the country (**eHealth Plan 2009 - 2015**). The prime objective of the recommendations outlined in the plan is to improve the healthcare provided to all citizens through an appropriate ICT strategy that will enhance the work processes of the Ministry of Health and Quality of Life, its departments and health agencies. In line with the E-Health Plan, the government is presently developing the E-health system that would ensure the computerization of all health services in hospitals, area health centres and Community health centres. This is a major building block towards having a National Health Information Systems that spans over the public and private health sectors. ICT will be used to facilitate the provision of health care to citizens.

(e) The **E-prison system** aims to make the management of prisons much easier through the use of Information and Communication Technologies (ICT), as a key enabler for Service Delivery and efficiency. The e-Prison system will provide opportunities for bringing in better security of the prison, safe custody of inmates, and facilitate the provision of rehabilitative programmes aimed at reforming prisoners.

(f) The **National ICT Strategic Plan (NICTSP) 2011 – 2014**: Towards i-Mauritius has called for a paradigm shift in our e-Government Strategy that advocates placing citizens at the centre of public service delivery. In this context, the government has recently carried out an assessment of e-Government needs and adequacy of existing infrastructures and an e**Government strategy Report** has been developed and approved by Cabinet in January 2014. The eGovernment Strategy takes stock of gaps between needs and availability of services and make appropriate recommendations for a more effective, secured and efficient delivery of Government services to citizens and businesses, the participation of citizens in decision making processes, the convenience of citizens and businesses in their interactions with the authorities and transparency and accountability in Government operations.

(g) An integrated web-based **e-Procurement System** (ePS) for the Public Sector that will improve its procurement processes and enhance transparency is in progress. The e-Procurement

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system aims to cover works, goods, services and consultancy services projects and to support key stakeholders, namely: Public Bodies, Central Procurement Board, Independent Review Panel, Procurement Policy Office, Ministry of Finance and Economic Development, Accountant General, National Audit Office and Bidders/Suppliers to conduct business online.

10.3.15 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:-

i. Leadership and Governance: Establish clear leadership and governance in information security risk management at national level and at level of organizations;
ii. Risk Mitigation: Establish mandatory information security risk management policy for critical sector operators to protect against cyber security threats.
iii. 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. It is expected to start from October 2014.

10.3.16 National Green IT Policy and Strategy

Recognising the importance of Green IT initiatives worldwide, a draft National Green IT Strategy and Action Plan has been developed. This project aims to provide Green IT Management Strategy, technology principles and standards, and a strong operating model to facilitate and implement Green IT at the national level. Five key strategic objectives have been recommended, namely:-

i. Establish an institutional framework to drive Green IT at a national level across government, private sector and civil society;
ii. Embed environmental performance across any stage of ICT projects;
iii. Measure, monitor consumption of non-renewable energy used to power ICT equipment and manage the carbon footprint;
iv. Reduce, re-use and recycle IT equipment to limit environmental impact; and
v. Accelerate, empower and promote awareness of Green IT to society in collaboration with international institutions.

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Green IT Awareness activities such as workshop for businesses, developing and disseminating guidelines on Green IT, essay and project competition at the level of secondary and tertiary institutions, training leading to industry certification, etc… are ongoing activities carried out by the National Computer Board.

10.3.17 EU Code of Conduct for Data Centres

In line with its initiatives to promote Green IT, the National Computer Board organised a capacity building programme on EU Code of Conduct for Data Centres (EUCOC) in May-June 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 affaires (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.

10.3.18 National eWaste Policy, Strategy and Action

This project is currently in progress where three experts funded by the European Union are developing the eWaste (electronic waste, electrical and electronic equipment) Policy, Strategy and Action Plan for Mauritius. The specific objectives of this project are to:

a) Assess and evaluate existing e-waste policy, initiatives, gaps, challenges and opportunities in/for the management of e-wastes in Mauritius.

b) Develop comprehensive national e-waste policy, strategies and an action plan for the environmentally sound management (ESM) of e-wastes in Mauritius.

c) Recommend appropriate economic and policy instruments and financing mechanism which will favour the ESM management of e-wastes in Mauritius.

d) Recommend appropriate legal, institutional and administrative framework for the ESM of e-wastes in Mauritius.

10.3.19 National Cyber Security Strategy for Mauritius

A national cyber security strategy and action plan for 2014-2019 has been developed. The implementation of the strategy will help Mauritius to better respond to cyber threats. The strategy

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defines four main goals. The action plan is spread over a period of 5 years for the completion of all projects.

The four defined goals of the strategy are as follows:

- To secure our Cyberspace and establish a front line of defence against Cybercrime.
- To enhance our resilience to Cyber Attacks and be able to defend against the full spectrum of Threats.
- To develop an efficient collaborative model between the authorities and the business community for the purpose of advancing National Cyber Security and Cyber Defence.
- To improve the Cyber Expertise and the comprehensive Cyber Security Awareness of all societal actors

10.3.20 National Open Source Policy, Strategy and Action Plan

A National Open Source Policy Strategy and Action Plan has been developed. The main objective of this project is to develop strategies and plans for reinforcing the use of Open Source Software to enhance value and improve efficiency within the Mauritian public and, indirectly, private ICT sector, SME's and boosts local capacity to help develop local knowledge communities. The Strategy document describes the OSS vision of the government to encourage ambitious and dynamic OSS ecosystem which will involve all stakeholders together, will integrate all of the existing knowledge, experience, ideas and enable development of new ideas, ways of cooperation and will be in mutual benefit of all stakeholders.

Four Strategic Pillars associated with specific goals and targets have been identified as necessary for the growth of an OSS ecosystem namely:

- OSS enabled education system on all levels
- OSS based research activities on universities and tertiary education
- Common place for all Open Source Software, Open Standard, Open Content and Open Data activities
- Common collaboration platform and technology platform

The project was funded by the European Union in February 2014 under the 10th EDF Technical Cooperation Facility at the cost of Rs2.4 million.

10.4 ICT Projects with Cross-border Potential

10.4.1 Regional CERT (AfriCERT)

AfriCERT (the Regional CERT for Africa), which is similar to APCERT for Asia Pacific, is a coalition of CERTs of African countries. It was setup in 2011 and officially incorporated in Accra, Ghana. Its main objective is to enhance the cyber security of African countries through effective collaboration and communication with all stakeholders concerned across Africa. Mauritian Computer Emergency Response Team (CERT-MU) is collaborating with the AfricaCERT. The latter shares malicious data

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(includes malware or bot, DNS Changer victims) for Mauritius with CERT-MU, which is collected from research honeypots using ATLAS sensors. CERT-MU liases with local ISP's to take necessary actions.

10.4.2 ICT Regional Exhibition

The main objectives of organising a Regional ICT Exhibition and Conference Event are to:

- Create awareness on emerging technologies;
- Sensitize on the potential applications of ICT and choice of technology for effective business and individual solutions;
- Sensitize on career opportunities in the ICT sector;
- Encourage people to go for higher level industry-based certifications;
- Promote and encourage ICT literacy; and
- Bring Government services closer to the people by providing accessible and integrated online public services.

NCB organises the Infotech ICT Regional Exhibition and Conference event on a yearly basis with the following objectives:

- Meet and participate in business exchanges with local and international players and stakeholders of the ICT sector
- Create awareness on achievements and developments in the ICT sector in the region
- Provide information on ICT products, services and technologies in the region
- Explore areas of collaboration and tie ups through networking activities

The 21st edition of Infotech is scheduled in November 2014 at the Swami Vivekananda International Convention Centre.

The NCB in collaboration with the Rodrigues Regional Assembly (RRA) also organised the first edition of Infotech Rodrigues in November 2012. Following the grand success of Infotech Rodrigues 2012, it has been decided to make Infotech a yearly event in Rodrigues. Infotech Rodrigues aims at creating more awareness on emerging technologies and bringing ICT closer to the Rodriguan citizens. The next Infotech Rodrigues event will be organised in August 2014.

The National Computer Board (NCB) and the Mauritius IT Industry Association (MITIA) jointly organised the 2nd annual edition of ProIT in May 2012, the first edition was organised in April 2011. ProIT is a professional B2B Exhibition and Conference event that enables operators of the ICT industry to showcase their expertise, products and solutions. The event targets mainly professionals of the ICT sector, SMEs, corporates and the business community. It is proposed to include more regional players from other countries to make the event an ICT Regional Exhibition and Conference.

The Ministry of Information and Communication Technology (MICT) in collaboration with the Board of Investment (BOI), the National Investment Promotion Agency of the Government of Mauritius,

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organised the first edition of 'International ICT-BPO Investment Forum 2013' in Mauritius on 6-7 June 2013. This Forum served as a leading platform for investments in the ICT/BPO sector. The main objectives were to attract potential investors in Mauritius and to showcase to the global investors' community what Mauritius could offer

A 3rd edition of the ICT-BPO International Conference was held in December 2013 to promote Mauritius as a preferred ICT-BPO hub and bringing the Global ICT Community and Outsourcing Professionals, Business Professionals together for Knowledge Sharing, and Networking experience. The ICT-BPO International Conferences was preceded by the Youth Engagement Summit (YES), whose objective is to place youth at the centre of Africa's ICT Development Agenda, is an initiative of the Ministry of Information and Communication Technology of Mauritius.

10.4.3 Regional Internet Exchange Point

The setting up of a regional Internet Exchange Point is to keep local contents within the region. Its purpose is to efficiently route all intra-Regional Internet traffic among the operators without having to pass through the United States or Europe. This will allow the regional data carriers to significantly optimize upstream capacity costs, enhance their existing bandwidth capacities and reduce the size of the routing tables worldwide

10.4.4 Regional Centre of Excellence

The setting up of a Regional Centre of Excellence is to foster ICT development in the region with objective to:

- Providing training to ICT professionals of countries in the African region
- Sharing of policy experience and know-how of developed countries
- Enhancing R&D in ICT

The ICT Academy, based on a Public-Private Partnership (PPP) model and industry-driven, was officially inaugurated on the 8th September 2014. The drive behind the project is to help Mauritius keep pace with latest developments as regards to the digital economy, knowledge economy, Internet economy and internet of things and train its human capital in that direction. The ICT Academy will help in capacity building and provide support in producing a skilled workforce capable to feed the growing ICT/BPO sector in Mauritius. The purpose is to address the problem of mismatch and shortage of ICT Skills.

10.5 National ICT Research Capacity and Priorities for Cooperation

10.5.1 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.

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- 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
- 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 Miscarriages
- Performance optimisation of database driven websites – Focused on boosting the software industry and creating skills software developers. Institutions involved include University Technology Mauritius, University des Miscarriages
- 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, University des Miscarriages 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

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10.5.2 National Research Capacity

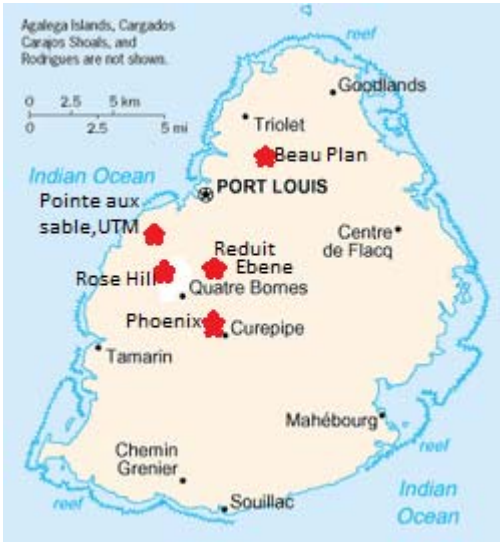
The table below provides an overview of universities in Mauritius with ICT/Engineering Courses for 2013:

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	12,492	2,986	9,314	1,370	1,408	379
University of Technology	Pointes-aux-Sable	3,909	792	3,199	523	610	109
Mauritius Institute of Education	Moka	2,943	-	115	-	80	-
Open University of Mauritius	Reduit	1,512	29	857	29	593	-
Universite des Mascareignes (ex- Swami Dayanand Institute of Management and Institute Superieure	Beau Plan	1,199	658	595	550	-	-
Mauritius Institute of Training Development	Phoenix	555	211[1]		-	-	-

Institution (Private)	Location	Total Students		Undergraduate Students		Post-Graduate (Masters, PhD)	
		Overall	ICT/Eng	Overall	ICT/Eng	Overall	ICT/Eng
Amity Institute of Higher Education	Ebene	369	48	249	48	150	-
C-DAC School of Advanced Computing	Quatres-Bornes	93	53	50	50	43	43
Charles Telfair Institute	Quatres-Bornes	1,820	52	1,009	52	62	-
Middlesex University (Mauritius Branch)	Ebene	260	888	233	81	27	7
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 (2014)

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 Mauritius**[74]

[74] http://www.uom.ac.mu

- Depots include: 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:

Department of Computer Sciences and Engineering

- ***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.

- ***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

- ***IPv6***

  IPV6 is the new generation Internet Protocol devised to replace the previous one (IPV4) which cannot provide sufficient internet addresses to cater for future needs. Also IPV6 provides for simpler configuration and better support for real-time data. The objectives of the group are to perform verifications on how the performance of different network-based applications can be improved using IPV6, how the QoS support available in IPV6 can be exploited and also to look into ways of helping the deployment of IPV6 in Mauritius.

- ***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

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Mauritius is working on a paper entitled “Access Control Mechanisms for Collaborative Context-Aware HealthCare Services in Mauritius”.

- ***Intelligent systems***

  The group concentrates on research in fields such as Biometrics, Computer Vision, Artificial intelligence and Human Computer Interaction.

- ***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. The focus will be making the group “one of the best in the region” to start with this.

- ***A Study of Online Social Networks (OSNs) in Mauritius: Impact on Secondary Education***

  This research project has investigated the roles that online social networks play in teaching and learning at secondary school level. This project was undertaken by University of Mauritius and Mauritius Research Council from June 2011 to August 2012.

  The findings showed that Mauritian students are using OSN sites extensively on a daily basis. It was found that students are already making use of OSNs to discuss school works and teachers also are communicating with students through these online sites.

  In addition, experiments have been carried out on the use of OSNs to conduct classes and observations have been reported. Results from this study have clearly shown the benefits of using OSNs in learning. Students were eager to make use of this new way of learning and therefore this can act as a motivating factor in the learning process. Policy makers can thus consider the results of this study in order to take decisions regarding the use of OSNs in secondary education. A number of recommendations based on the study have been made on how OSNs can be integrated in formal education. The project was completed in 2013.

- ***Investigate & Forecast the Future Energy Demand and the Potential of Renewable Energy to Mitigate GHG Emissions***

  This project is a major platform to support the government of Mauritius in its quest to implement the ‘Maurice Ile Durable’ concept. It was undertaken between November 2011 and May 2012. The study provides evidence of present electricity demands and consumptions as well as Greenhouse gases (GHG) emissions resulting from power production. The purpose of the project is to investigate and forecast the future electricity demand and supply by formulating an adequate model using the LEAP tool. For the study,

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three scenarios were developed, namely: Business-As-Usual (BAU), Demand-Side-Management (DSM) and Optimum scenarios. The BAU scenario represents a base case scenario with no policy intervention, the DSM scenario study the potential of electricity conservation technologies while the optimum scenario investigate the potential of Renewable energy technologies (RETs) in the power sector.

- ***Study of Waste Collection Systems in two Local Authorities***

  The project focuses on the assessing on a pilot basis the current waste collection facilities in for a particular Municipality and District Council, in order to formulate guidelines for the National recommendations pertaining waste collection and transportation, for the Ministry of Local Government and Outer Islands (MOLG). For this purpose, systems dynamic models are developed to understand and optimise the waste collection process.

  This project is still ongoing.

- ***Pose and light invariant Face and Ear Recognition System***

  Biometrics authentication consists of methods for uniquely recognizing humans based upon one or more intrinsic physical (e.g. face, iris, fingerprint, ear) or behavioural (e.g. typing rhythm, gait) traits. This research work will concentrate on problems related to face and ear recognition systems. The existing face recognition systems are prone to errors whenever there is a change in pose and lighting in the picture of subject concerned. The problem is then to tackle the varying pose and light condition issues.

  This project was completed in 2013.

- ***A Secure Data Access Model for the Mauritian Healthcare Service***

  This project ran from November 2010 - February 2013, funded by the Mauritius Research Council.

  The aim of this project was to study the applicability of Role-Based Access Control (RBAC), supported by Context-Based Access Control (CBAC), to perform control access to patient data in a typical healthcare service. The project consists of the analysis of the healthcare information system in a private clinic of Mauritius and study of design and implementation issues of providing access control to such a system, based on RBAC and CBAC. The work includes the development of a prototype so as to enable to researchers to be exposed to practical issues that crop up in the application of such concepts to real-life data. This project was completed in 2013.

- ***Development of an open platform for "Volunteer thinking"***

  This project is funded by International Development Research Centre (IDRC), a Canadian funding agency, as a wider effort to promote open science. The initial investigation will look into how problems can be broken down into tasks so that they can be outsourced to

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volunteers, an undefined public. A proposal is actually being sought out in collaboration with researchers from CERN and co-founders of the Open Knowledge Foundation. The considered direction is how problems related to skin lesions in developing regions can be applied with crowd-based analysis to detect skin cancers as well as other diseases.

This project commenced in July 2012 and is ongoing.

- ***Automatic Suspect Behaviour Recognition System***

  This project aims at tracking body movements and detecting suspect behaviours. The motivations for this work are to prevent accidents and crimes. The existing video surveillance systems try to verify how (and people) after an event has taken place while this project work will try to detect suspect movements and activate alarms to allow for intervention by appropriate authorities. The outcome of this project work can also be useful to vulnerable members of the society like under-aged and old people. This project started in Nov 2013.

- ***Setting up a data warehouse for infectious diseases***

  This project will consist of the development of a data warehouse, at the University of Mauritius, for infectious diseases caused by bacteria. It will consist of the development of the required software tools that will access bacterial genome databases, perform the filtering for relevant data, cache the appropriate data at a local data store at the UoM, and provide a user-friendly interface to the data.

  The main aim of this project is to encourage the development of Bioinformatics research on bacteria-based infectious diseases, in Mauritius, by providing fast-access to an up-to-date data store that is easy to use. This project started in Nov 2013.

- ***A Sustainable Green-Computing Framework for Clusters of ICT Equipment***

  The University of Mauritius carried out a case study to investigate various energy consumption and demand patterns in Computer Laboratories as well as server rooms, in order to formulate an adequate framework gearing towards a sustainable solution to resolve the high energy usage of clusters of ICT equipment. This project focuses on analysis of energy model for studied clusters and formulation of a sustainable Green-Computing framework to assist institutions/organisations having major dependencies on clusters of ICT equipment. This project started in Nov 2013 and is still ongoing.

- ***Scalable Video Surveillance System for Suspect Behavior***

  This project involves automatic recognition of body movements from Video Surveillance Systems. It started in Feb 2014 and is still ongoing.

- ***Building a Biometric Database of Palmar and Dorsal Hand Patterns***

  This project involves Image Capture for biometric security using hand features. The project has been completed

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- ***Wireless Sensor Network System for Precision Agriculture***

  Development of clustering and routing algorithms for the transmission of data from agricultural fields to the base station for analysis. This project is still ongoing.

Department of Chemical & Environmental Engineering

- **Cane Resources Network for Southern Africa, 2002-2008**

  The Cane Resources Network for Southern Africa[75] (CARENSA) will critically assess the role of bio-energy from sugarcane in promoting sustainable development and improving global competitiveness in the region of southern Africa. The main objective of CARENSA is a comprehensive synthesis and comparative evaluation of the utilisation of cane resources in the region, including organisational and institutional dimensions as well as technical features and socio-economic and environmental impacts. The European Commission's Directorate General for Research supports the thematic network in the amount of 500.000 EURO. The Stockholm Environment Institute (SEI) serves as Scientific and Administrative Coordinator for the Network. There are three other principal contractors responsible for the Network and nine members. The project team was designed to place the key issues in their proper regional and global context, while also promoting north-south and south-south cooperation on cane resource development.

- **Collaborative Curriculum Development on Waste Management in Africa and the pacific Region (CODWAP), 2008-2011**

  As Solid Waste Management (SWM) is dominated by economic capacity constraints, CODWAP[76] focuses on a number of issues, which are often overlooked in African and Pacific Region (APR) countries over other priorities (mainly irrigation and sanitation). CODWAP aims to establish an active and sustainable co-operation forum on curriculum development, which is consistent with APR socio-economic development priorities. The development of SWM educational tools, which are customised, easy-to- use, practical and suitable to the needs and priorities of the participating APR countries, is formulated around a Master Course on SWM (to be piloted by the University of Mauritius), as well as a number of related training courses, both in the EU and APR countries.

- **Small Developing Island Renewable Energy Knowledge and Technology Transfer Network (DIREKT), 2009-2012**

  Network (DIREKT)[77] is a cooperation scheme involving universities from Germany, Fiji, Mauritius, Barbados and Trinidad & Tobago with the aim of strengthening the science and technology capacity in the field of renewable energy of a sample of ACP (Africa, Caribbean,

[75] http://www.carensa.com/
[76] http://acp-edulink.eu/content/codwap-collaborative-curriculum-development-waste-management-africa-and-pacific-region-0\
[77] http://www.direkt-project.eu/

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Pacific) small island developing states, by means of technology transfer, information exchange and networking. Developing countries are especially vulnerable to problems associated with climate change and much can be gained by raising their capacity in the field of renewable energy, which is a key area.

The project was funded by the ACP Science and Technology Programme, and EU programme for cooperation between the European Union and the ACP region (Africa, Caribbean, Pacific).

- **Re-Sources Network, 2012-2017**

  The project is focused on Solid waste Management in Western African countries.

- **L3EAP, 2013 - 2016**

  The purpose of the L³EAP[78] project is to increase 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.

  The three-year half million Euro project is coordinated by Hamburg University of Applied Sciences in partnership with USP, University of Mauritius and Papua New Guinea University of Technology. The project is ongoing.

- **University of Technology, Mauritius[79]**
  - 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:

  - ***Implementation of a USSD API***

    Development and implementation of an open USSD Enabler for the Emerginov platform. Completed in 2011.

  - ***Digital Propagation models for Mauritius***

    A statistical model of digital propagation has been developed. These models were tested on the data they were developed from with good results. The models had also been tested on

[78] http://project-l3eap.eu/
[79] http://www.utm.ac.mu

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new data collected from the areas from which the original data was collected with very satisfactory results. In addition to this, each of the models was tested on data from the rest of Mauritius and it had been shown that the two models were sufficient to model digital propagation in the whole of Mauritius. This project has been completed.

- ***A technology independent framework for partitioning and retracting context awareness***

  In this project, an application partitioning and retraction framework is being proposed for next generation applications that will have the capabilities to seamlessly partition and retract themselves on multiple computational nodes in a pervasive environment.

  This project commenced in May 2012 and finished in September 2013.

- ***Formulation of a unified data mining theory through composite functions***

  The pattern extraction and discovery of useful information from a dataset are the foremost purposes of data mining. For the past decade there have been multiple attempts and strong beliefs in the development and formulation of the unified data mining theory that would answer to the fundamental versions related to the discovery of knowledge. We are proposing a novel unified data mining theory conceptualized through the composite functions. This project commenced in June 2004 and finished in December 2012.

- ***Web caching algorithms for highly customizable portals***

  The aim of the research is to propose a content management that can dynamically update port lets configuration based on usage and port let change at the content producer. This project commenced in April 2007 and finished in December 2012.

- ***ERP for SMEs***

  This research project will lead to a final Framework, which is based on Modelling Concepts and Scenario Development on ERP and what are the adoption and acceptance denominators towards an ERP. This project commenced in December 2008 and is due for completion in October 2014.

- ***Learning difficulties in geometry***

  Geometry is a vital part of mathematics but research has shown that pupils are not demonstrating strong conceptual knowledge of the geometrical skills and are failing to learn basic geometrical concepts as much of the learning has been done by rote. In Mauritius, as well, teachers have reported that pupils found geometry abstract and difficult and the textbooks cover geometry in only a few pages. Rote learning of the properties of shapes for examination purposes is a common practice in schools. This study aims at investigating the performance of upper primary pupils in two-dimensional geometry; to what extent can the use of inquiry-based teaching and/or Creole as means of instructions improve learning and retention of two-dimensional geometry; and what is the relative impact of pupils' home

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backgrounds and pupils' characteristics in determining performance in geometry. This project commenced in January 2008 and finished in December 2012.

- ***Secure access through authentication and biometrics/smart cards technologies***

  The purpose of this study is firstly to conduct a comparative analysis of different existing authentication techniques followed by identifying potential flaws in existing authentication systems and implementing possible improvements in view of selecting best Biometric Technology (or Technologies) suitable for smart cards. At an advanced stage of the research, we shall design cryptographic technique(s) adapted for biometric applications in smart cards. This project commenced in January 2012 and is due for completion in October 2015.

- ***GPU Computing with iterative solution methods***

  Mathematical modelling of various scientific and engineering systems often boils down to solving partial differential equations using efficient and very stable solvers. In recent years, several high-order schemes for two-dimensional convection-diffusion equations have been proposed. In this research work, using the CPU-GPU computing environment, the optimization of numerical algorithms for solving the large sparse linear systems of algebraic equations generated from the schemes will be investigated. This project commenced in January 2012 and is due for completion in October 2015.

- ***Reliability assessments and predictions over mobile and ubiquitous computing***

  Mobile and Ubiquitous computing have opened up several new avenues for the whole world. The aim of this investigation is to study the factors that contribute to reliability in this field and how to work with them in order to assess and predict, improve the reliability features, what should be the desired levels of reliability metrics identified. This project commenced in May 2011 and is due for completion in July 2015.

- ***Intrusion forensics***

  The research aimed at providing a solution to code/data confidentiality of mobile agent based on an adapted implementation of the Bell-Lapadula model for access control. Experiments will be conducted on mobile agents programmed in Java on the JADE middleware platform for agent execution. This project commenced in Sept 2005 and nearing completion.

- ***Security framework to combat attacks On SIP-based VoIP networks***

  In this project, a security framework will be developed and will focus on detecting some of the VoIP attacks and classification of these attacks as real or automated scenarios by using the concepts of pattern recognition method. This project commenced in May 2008 and is due for completion in June 2015.

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- ***Harnessing the potential of ICT to influence learning of mathematics at the beginning of secondary schooling***

  The aim of this research is to investigate the possibility of using ICT in the learning system with the view of improving the study of mathematics in lower forms at secondary level. This project commenced in January 2012 and is due for completion in July 2015.

- ***Krylov subspace method for eigenvalue problem and its applications***

  This project aims at developing and enhancing algorithms for the solution of harmonic eigenvalues, that is, interior eigenvalues of the spectrum. Furthermore, the thesis focuses on the application of the Eigen problem algorithms in the field of multimedia and technology; for example, face recognition and image compression. This project commenced in December 2008 and is due for completion in December 2015.

- ***Energy modelling for sensor networks***

  The objective of this work is to contribute towards enhancing the lifetime of sensor networks. This project commenced in June 2008 and is due for completion in June 2015.

- ***Software tool for option pricing***

  All major financial institutions and investors make use of option contracts to speculate on trends in the stock market or to keep their level of risks from other investments under control. The price of an option is determined in order to prevent arbitrage. In this project work, we will focus on the development of new numerical schemes for pricing European, American and Asian options under different models. This project commenced in December 2008 and is due for completion in December 2015.

- ***Performance optimization of database-driven websites***

  This research will address the problem of bottleneck present in Relational Database servers by using the new HTML5's web storage capabilities to model a client side query caching mechanism. This project commenced in January 2012 and is due for completion in June 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***

  This project aims to allow users with basic or no knowledge of C/C++ to use and access arduino remotely through a secure web API. The design phase is complete, and has been presented to Orange Labs in December 2012. A fully functional prototype was available from mid June 2013 for testing purposes.

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- ***Matrix equations with fuzzy parameters***

  This project aims to develop efficient algorithms for the solution of the discrete-time Sylvester matrix equation when the equation is partly or fully fuzzy in nature. Project started on 30 April 2013 with a duration of seven years on a part time basis

- ***Numerical pricing of life insurance and annuities***

  This project aims to develop fast and efficient state of the art numerical algorithms to price life insurance and annuities. Project started on 30 April 2013 with a duration of seven years on a part time basis.

- ***3D Compression for multimedia systems***

  This project aims to research 3D compression techniques that can be used in mobile networks for optimized compression. Project started on 30 April 2013 with a duration of seven years on a part time basis.

- ***Feasibility of IPv6 in Cellular Networks***

  This research project consisted of looking at the issues in implementing IPv6 over a GSM network in the Mauritian landscape. The project outcome was a roadmap and successful deployment of cellular calls with IPv6. The project is under a non-disclosure agreement between the university and a mobile operator and has been completed.

- ***Triple Play Services on PLC***

  The feasibility for broadband transmission over Power Line Communication was demonstrated theoretically. Investigation on triple play services on PLC is the core of this research project. The project is on-going.

- ***Scaling Up IoT and M2M with IPv6***

  The limitations of SIM and IPv4 addressing is a major obstacle towards scaling up IoT and M2M. Based on M2M applications developed, we are exploring scalability issues. The project is at the initial stage.

- ***Energy Information Systems with Agile Techniques***

  This research project sheds light on the importance and benefits of having an EIS across state members or regional blocks. The project is on-going.

- ***Predictive Analysis using Time and Space Series for Carbon Footprint in Mauritius***

  This project involves data acquisition on a massive scale (big data) using a smartphone and sensors in view of predicting acidity of seawater and other environmental indicators. The project is at the initial stage.

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- ***Transition models from traditional to SDN networks***

  Proposed transition models from existing networks towards SDN networks are tested in a simulation environment. The project is ongoing.

- ***Optimal Harvesting Strategies for Fisheries***

  The project is ongoing.

- ***High order methods for solving option pricing problem***

  The aim of the project is to study high order methods for numerically approximating linear and non-linear option pricing problems. The project started in 2014 with a duration of seven years on a part time basis.

- **Mauritius Research Council**[80]
  - Research areas include: Wind turbine Technology; Technology-Enhanced Learning; IPV6
  - ***Adaptive Coding Techniques for Time Varying Channels***

    Forward error correcting codes applied to time varying channels must be designed so as to give the desired sink error rate for the worst case channel state. Thus when the channel is relatively error free, much unnecessary error control power is being used, causing a reduction in overall information rate. An adaptive coding scheme employs only the necessary degree of error correction to be applied and so improves the information's rate and through put efficiency.

  - ***Developing successful entry strategies for BPO operations in Mauritius***

    The major objectives of this project is to study the types of BPO services outsourced and identify which ones are most suited for the Mauritian economy. The main activities involved in this project is the studying of the Mauritian environment related to BPO activities and available infrastructure and conducting a survey in some existing companies currently providing BPO services to identify their services, gauge if they meet the required criteria such as track record in BPO, specialization in the business processes to be outsourced, available experience in the company's industry. This project is completed.

  - ***Electronic Commerce tools and Methodology using web-based technologies***

    Electronic commerce is rapidly emerging as a new model for trade transactions and the web-enabled architecture is opening up tremendous opportunities for information dissemination and information sharing. This research is innovative in developing a set of tools, methodology and services targeted for local enterprises to benefit from the technology. The research will also contribute in clarifying the needs for the proper institutional and legal

[80] http://www.mrc.org.mu/

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framework that will be required so as to fully exploit the technology. This project has been completed.

- ***Evaluation of importance of corporate e-learning in providing a competitive edge to Mauritian companies***

  The anticipated results of the research would enable CSL to know whether companies in Mauritius are willing to adopt e learning as a supplement to corporate classroom training as well as providing insights into priority areas and training needs for e learning in Mauritius. This project has been completed.

- ***A Study of Online Social Networks in Mauritius: Impact on Secondary Education (undertaken with University of Mauritius)***

  Since no prior research about the usage of Online Social Networks (OSNs) by secondary students in Mauritius has been carried out so far, our first objective will be the gathering of data, both quantitative and qualitative about students' usage of OSNs. This will be done through surveys and interviews of both students and teachers. The raw data itself will be very useful for future research works in the area since it is currently unavailable for Mauritius.

- ***A Secure data access model for the Mauritian Healthcare Services (undertaken with University of Mauritius)***

  The project consists of the study of the RABC and context-based access control techniques, their applicability to the Mauritian healthcare service and the development of a prototype based on these techniques. The project started in October 2020 and completed in October 2012.

- ***Development of a Locally Designed Wind turbine Technology***

  The project shall consist of developing a small low cost wind turbine locally and for the local harsh conditions with a view to power up individual houses with a low to medium income or as a complement to the electricity grid systems. The market ultimately is aimed at the remote areas within our region and will benefit outer islands for Mauritius. This project has been completed.

- ***Supporting QoS in Mobile IPv6 Systems***.

  This project started in March 2009 and is still ongoing.

- **Open University of Mauritius**[81]

  - Research areas include: Simulation Software, Cloud Computing, Software and Services, Multimedia, Content Access and Analytics, Data Mining, Cognitive Systems, Advanced

[81] http://www.open.ac.mu

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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***

  This project started in July 2014 and expected to completed by end of this year.

- ***Dr Maths – A project intended to provide students tutorial help in mathematics using mobile phone apps.***

  This project started in July 2014 and expected to completed by June 2015.

- **Charles Telfair Institute** [82]
  - Depts include Faculty of IT
  - Research areas include: Green ICT, Digital Divide, Technology-enhanced Learning, IT Governance, Digital Inequality, Cloud Computing

  Examples of research expertise and types of projects undertaken are provided below:

  - ***Development and Evaluation of IT Governance and Green IT Model to Support Large Mauritian Organisations***

    Getting the Information System (IS) that meets the exact requirements of a business is often tricky. In addition, managing business IT in an eco-friendly manner is also a matter of concern, as key business stakeholders turn into fervent sustainability advocates. This research combines both these issues into one with the aim of producing a model for large Mauritian organisations to guide their business leaders wishing to adopt an IS strategy that would best suit their business and promote environmental sustainability. It is funded by Curtin University's COPRS (Curtin Offshore Partner Research Scholarship).

  - ***Digital Inequality: The Internet in Mauritius***

    The research focuses on the following four objectives. Firstly, to develop a clearer understanding of the term Digital Inequality; Secondly, to investigate the diffusion of Internet, in the developing island state of Mauritius since its mainstream dissemination and the current state of affairs; Thirdly, to identify the main causes/determinants of Digital Inequality in Mauritius and finally, to situate governmental and non-governmental initiatives with regards to the main determinants of Digital Inequality in Mauritius. It is funded by Curtin University's COPRS (Curtin Offshore Partner Research Scholarship) and is due to end by June 2015.

  - ***Developing robust businesses with the power of cloud computing Among SMEs***

[82] http://www.telfair.ac.mu

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The objective of the study is to show the extent to which the disclosure of information could develop trust among stakeholders for the development of robust businesses. Cloud computing, which uses web-based technologies, could contribute to disclose information faster among stakeholders. The furniture industry, in Mauritius, is fragmented and facing aggressive foreign competition. Porter has developed an integrated framework which highlighted the benefits of information. The application of web based technologies to the porter's framework could benefit the SMEs sector to develop robust and sustainable businesses.

- ***Social Media Marketing: An investigation into SME practices in Mauritius; a case study approach***

  The purpose of this study is to analyse the usage of Social Media Marketing (SMM) as a tool for Small and Medium Enterprises (SME). It identifies the ways and means that SMEs in Mauritius can use to broaden their scope for growth. The study is geared towards uncovering the impacts of the shifts in marketing from using the traditional forms of marketing to new perspectives in marketing strategy. A mixed method would be used for this research which would comprise of both qualitative and quantitative measures. Various researches have been done in regards to Mauritian SMEs and marketing in Mauritius but they did not expose whether the usage of SMM can bring a significant difference to the expansion of SMEs in Mauritius. This research will lead to firstly filling gaps in literature in regards to SMEs and secondly devising a model which can be adopted by SMEs to increase their performance via the usage of SMM.

- ***"Participatory culture and education: A roadmap to the integration of participatory culture in the curriculum"***

  In a Mauritian context, the universities and tertiary institutions have also adopted the two-way web or Web 2.0 in the learning environment. There are various Web 2.0 applications, including blogs, wikis, social networking sites, pod casting, among others that have found their way in the education sector. However, as universities and tertiary institutions have started using this social software, the level of investment of Mauritian learners is still desirable. This research will therefore investigate a set of research questions relating to the participatory culture and higher level education in the Mauritian context. The first priority is to find the core problems among learners that are creating barriers for their active participation in the learning environment. This research will provide an investigation that will allow the creation of a model to integrate participatory culture in the curriculum.

- ***Are online tertiary courses a major threat to tertiary institutions?***

  With the increasing number of online course providers and the opportunity of having a degree at cheaper rate and at one's own convenience, this research will investigate on the

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impact of online courses, their target audience and on the impact it might have on tertiary institutions.

- ***The role of cognitive and non-cognitive factors as predictors of academic performance: identifying the determinants of disengagement from higher education***

  This research will focus on identifying the cognitive and non-cognitive factors affecting academic performance of students enrolled in higher education institutions. Factors such as intelligence, personality, learning styles, previous grades and socio-economic status will be investigated. The study will also determine the factors that influence students to withdraw, dropout or get terminated from universities. The link between academic performance and disengagement from studies will be investigated.

  This research explores issues pertaining to the performance of cultural memory in Mauritius and build upon previous research on transoceanic rhythmic connections between the Indian Ocean and the Caribbean. This research further explores rhythmic memory of indentured labour and the connective rhythms we share with South Africa. The circulation of Mauritian Bhojpuri rhythms in South Africa and the celebrated cultural memory of Malagasy inheritance through dance and ritual are further dimensions of Indo-oceanic cultural memory.

- **Université des Mascareignes** [83]
  - 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***

    Providing web users with a more effective, efficient and satisfying web search experience. This project started in 2009 and will end in 2014.

  - ***Use of ICT/Distance learning in Education***

    Creation of a platform for virtual campus. This project started in 2010 and is still ongoing.

  - ***E-marketing/Social Media***

    Analysing the use of social media as a relationship marketing tool in the retail sector. This project started in 2012 and is still ongoing.

  - ***Impact of CRM in Higher Education***

    This research paper seeks to understand and evaluate the potential of implementing a Customer Relationship Management (CRM) framework in higher education in Mauritius with

[83] http://www.udm.ac.mu/

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special reference to the Université des Mascareignes. The article was published on "Commerce Spectrum".

- ***Strength development in soils of volcanic origin, stabilized with fly ash***

  Effect of fly ash on the strength properties of dark magnesium clay. This project is completed.

- ***Web/mobile based traffic fluidity monitoring at Bel Air/ Rivière Sèche***

  This project is about the survey, computation, and digital presentation of the weekly fluidity of road traffic at Bel-Air Riviere Sèche. The village has only one two-way main road (named as the Royal Rd) of about 1.7 km passing through the entire village. This project started in December 2013 and is expected to be completed by December 2014.

- ***Heuristic Search Procedures for Cryptanalysis***

  This is an MPhil/PhD research project being carried out at University of Mauritius. Use memetic algorithms and design new/improved algorithms for the cryptanalysis of existing standard ciphers. This project started in 2014 and will be completed by end of 2018.

- ***Just-in-time diabetes assistance using mobile and web technologies***

  The aim of this project is to develop a pilot system that will enable diabetes patient to input their daily food consumption and daily glucose test result via a mobile application that will be uploaded on a central database so that it can be monitored by medical practitioner in case remedial actions need to be taken the message is sent immediately to the patient. This will provide "just-in-time", "anywhere and everywhere assistance". The patient will also have the possibility to ask question related to his health via mobile message which will be sent to a database so that it can be processed by the assigned doctors. The project will be divided into two parts: one using mobile technologies and one using web technologies, but they will be using the same web service. The project started in January 2014 and is expected to end by December 2014.

- **Middlesex University, Mauritius** [84]

  - Research areas include: User Interfaces, Big Data, Cloud Computing, Business Information Systems

Examples of research expertise and types of projects undertaken are provided below:

- ***Assessment of energy efficiency metrics***

  This research focuses on energy efficiency assessment (Green ICT). The increasing dependence of human beings on technology has not only made ICT a growing power consumer, but also a rising contributor to the adverse effects of global climate change. In light of the growing power consumption by ICT, accurate measurement techniques are

[84] http://www.mdx.ac.uk/facilities/location/mauritius/index.aspx

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required since leaders cannot manage what cannot be measured. The research activities emphasises on the assessment of energy efficiency metrics in addition to the continuous evaluation of the maturity of Green ICT practices at organisational level.

- ***Study of the ubiquitous usage of mobile services and applications***

  This research, which is funded by the Tertiary Education Commission, deals with the study of the ubiquitous usage of mobile services and applications for successful m-Government deployment in the Mauritian ecosystem. It aims at uncovering the barriers to increased mobile apps usage, mobile content creation and m-commerce, and devising ways and means to boost their adoption by the Mauritian people, thereby creating better conditions for successful m-Government services deployment in Mauritius. The fundamental problem that this research will address is the very slow uptake of mobile applications and services in the Mauritian ecosystem. Compared to the vibrancy of global mobile applications and services markets, Mauritius is lagging behind when it comes to riding this new wave of technological innovation and social transformation.

- ***Data governance relative to the concept of Big Data***

  This research is related to the field of Information Systems Management, particularly to the data governance area relative to the concept of Big Data when powered by Cloud Computing. Big Data basically refers to the use of huge amount of data at the disposal of organisations nowadays whereas Cloud Computing basically refers to elastic computing power at the disposal of customer organisations. There is a major need for data governance nowadays due to increases compliance and regulatory measures being adopted by governments and industry groups worldwide. However, many of the current data governance frameworks are not adapted to the changing technology architecture brought about by Big Data and Cloud Computing.

- ***Introduction of augmented reality as a pedagogical tool to enhance learning at tertiary level in Mauritius***

  This research at Middlesex University has been funded by the Mauritius Research Council with the aim to introduce Augmented Reality (AR) in the teaching curriculum of our educational system. How humans perceive and experience their surroundings is often dictated by how their senses are stimulated. Augmented Reality offers an interface with the potential to provide a powerful method of visualisation and interaction to its end-users. The research undertaken will identify and explore the derived benefits at tertiary level. This study would be the building blocks to a larger consortium with the aim of supporting new policies on the benefits derived from integrating novel methods of Human Computer Interaction (HCI) in academia to enhance student performance.

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- **Mauritius Institute of Health**
  - Research areas include: Health systems Research, epidemiological studies and the evaluation of health programmes, characterisation

Examples of research expertise and types of projects undertaken are provided below:

- **Use of ICT tools in Healthcare and home follow-up of patients**

  The Mauritius NCD Survey 2009 shows that the prevalence of type 2 diabetes in the Mauritian population aged 20-74 years was 21.3% and among those people known to have diabetes, control of their diabetes as judged by blood glucose levels was poor (47% had Hba1c≥9.0%), indicating very high risk of developing diabetic complications. ICT applications for out-of-hospital monitoring and treatment are promising tools to improve treatment compliance, promote individualised care and obtain a person centred care. One specific patient group of interest is monitoring and in-home follow-up of patients suffering from Type 2 Diabetes.

- **A study of ehealth prospects and challenges in Mauritius**

  With emerging Internet penetration coupled with advances in networking and information communication technologies, the e-health strategy has been introduced and accepted as a crucial and important element in healthcare systems.

  This survey will systematically examine the prospects and identify the challenges of ehealth strategy in Mauritius and model out an appropriate framework for its adoption and optimal utilization to enhance the healthcare services in Mauritius.

- **HIV Infection and risk behaviour among seamen in the Indian Ocean**

  The project started in 2008 and had duration of 10 months. It was funded by the Indian Ocean Commission (COI).

- **Medicine price availability, affordability and price components in the Republic of Mauritius**

  The project started in 2008 and was of 10 months duration. It was funded by the WHO

- **International tobacco control (ITC) policy evaluation project: ITC Mauritius survey (Cohort Study)**

  The project started in 2009 and was completed in 2012. It was funded by the University of Waterloo.

- **Mauritius birth defects registry**

  The project started in 2011 and is ongoing. It is funded by the Ministry of Health and WHO.

- **National Cancer Registry**

  The project started in 2005 and is ongoing. It is funded by the Ministry of Health and WHO.

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- **Social and Economic Determinants of Health**

  The project started in 2011 and was completed in 2013. It is funded by the WHO.

- **Contraceptive Prevalence Survey 2014**

  The project started in 2012 and is expected to end by December 2014. It is funded by the UNFPA

- **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 expertise and types of projects undertaken are provided below:

- **2010 Land Use Map of Mauritius using satellite imagery**

  The project started in 2008 and ended in 2011.

- **Production Environment of sugarcane crop for Miller/-Corporate planters (2000-2010). Project Crop improvement 4.7**

  The project started in 2009 and is expected to be completed in 2014.

- **Efficient conjunctive use of water for sustainable sugar cane production (software development for real-time irrigation management)**

  The project started in August 2010 and expected to end by 2015. It is funded by the EU Sugar Research Program.

- **Weed Identification and Knowledge in the Western Indian Ocean (database and software development)**

  The project started in November 2013 and will end by the end of 2016. It is funded by the EU ACP-Sugar Research Program.

- **Production Environment of sugarcane crop for Miller/-Corporate planters (2000-2010). Project Crop improvement 4.7**

  The project started in 2011 and will end by 2016. It is funded by the EU ACP-Sugar Research Program

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10.5.3 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
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
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;
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

10.5.4 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	**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 Computing **Mauritius Research Council**: Simulation Software **Open University of Mauritius:** Simulation Software

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Future Internet	**University of Mauritius (Computer Science and Engineering Department):** Software agents, Software oriented services **University of Technology Mauritius (School of Innovative Technologies & Engineering):** Mobile Computing, Future Internet **Université des Mascareignes** - Softwares and Services, Heuristic Search Procedures for Cryptanalysis, Mobile programming **Middlesex University, Mauritius:** Cloud Computing
Content Technologies & Information Management	**University of Mauritius (Computer Science and Engineering Department):** Metadata Development, Ontology Engineering **Open University of Mauritius:** Content Access and Analytics, Data Mining, Advanced Interfaces **Middlesex University, Mauritius:** User Interfaces, Big Data **Université des Mascareignes** - algorithms for web information retrieval, customer relationship management in higher education **Mauritius Sugarcane Industry Research Institute** - Statistical analysis and visual computing, big data technologies
Robotics	**University of Mauritius (Mechanical and Production Engineering Dept):** Computational Intelligence, Human-Computer Interaction **Open University of Mauritius -** Cognitive Systems, Advanced Interfaces

Horizon 2020 Societal Challenges	**Institution, Relevant Dept and Research area**
Health	**University of Mauritius (Computer Science and Engineering Department):** Health Patient Records, Healthcare Information Systems **University of Technology Mauritius (School of Sustainable Development and Tourism):** Occupational Safety and Health, Environmental Health **Open University of Mauritius** – eHealth, Integrated Care **Université des Mascareignes** - eHealth **Mauritius Research Council & Mauritius Institute of Health** – Understanding Health, Wellbeing and Disease

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Food Security, Sustainable Agriculture	**University of Mauritius (Dept of Chemical & Environmental Engineering):** Sustainable Agriculture & Bio-Economy **University of Technology Mauritius (School of Sustainable Development and Tourism):** Supporting development of bio-economy **Mauritius Research Council** – Aquatic Living Resources **Mauritius Sugarcane Industry Research Institute** - Development of biopesticides, production of bioplastics, Sugarcane productivity in various agro-ecological zones
Energy	**University of Mauritius (Dept of Chemical & Environmental Engineering and Mechanical and Production Engineering Dept):** Energy engineering and management, Renewable energy technologies; Energy security access and efficiency **University of Technology Mauritius (School of Sustainable Development and Tourism):** Energy Efficiency Management Programs **Mauritius Research Council:** Low-Carbon Electricity Supply; Alternative Fuels and Mobile Energy Sources; New Knowledge and Technologies **Charles Telfair Institute:** Green ICT **Mauritius Sugarcane Industry Research Institute -** Efficient use of energy resources in sugarcane processing
Smart, Green and Integrated Transport	**University of Mauritius, Department of Chemical & Environmental Engineering:** Green Transport **University of Technology, School of Sustainable Development and Tourism:** Socio-Economic Research Transport Management Systems **Mauritius Research Council:** Socio-Economic Research and Forward Looking Activities for Policy Making **Université des Mascareignes**: Web/mobile based traffic fluidity monitoring
Climate Action, Environment, Environment, Resource Efficiency and Raw Materials	**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 **University of Technology Mauritius (School of Sustainable Development and Tourism):** Sustainable Environment Management, Tourism, Leisure, Society and Education, Green IT, Sustainability Assessment, Tourism development and assessment, Transition Towards a Green Economy and Society, Service

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	Experience and Economy **Université des Mascareignes:** Climate Change & Environment **Mauritius Sugarcane Industry Research Institute:** Identification of agro-ecological zones' boundary with climate change for adapted sugarcane production and management **Middlesex University:** Geospatial Analysis
Inclusive, Innovative and Reflective Societies	**University of Technology Mauritius (School of Sustainable Development and Tourism):** eServices **Mauritius Research Council:** Inclusive Societies **University of Technology Mauritius (School of Innovative Technologies & Engineering):** Technology-enhanced Learning **University of Mauritius, Virtual Centre for Innovative Learning Technologies:** Technology enhanced learning **Charles Telfair Institute:** Technology-enhanced Learning **Open University of Mauritius:** Technology-enhanced Learning; eGovernment Services **Université des Mascareignes:** Technology-enhanced Learning; social media and e-marketing
Secure Societies	**University of Technology Mauritius (School of Sustainable Development and Tourism):** Resilience to Crises and Disasters **Université des Mascareignes:** Secure Societies **Open University of Mauritius**: Cybersecurity

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.

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

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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 of Mauritius in IST-Africa also provides the opportunity to learn about projects and good practices from other countries that can be adapted and replicated locally.

As a result of the participation of Mauritius in the IST-Africa Consortium, research institutions in Mauritius have become much more aware of the Framework Programme and specific calls and more pro-active about research. For example, the University of Mauritius was involved in a project proposal entitled "An Integrated Framework of Enhanced Transmission Strategies for LTE Advanced" in connection with the ICT Call 8 (FP7-ICT-2011-8) but unfortunately it was not funded.

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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 Província and Maputo-Cidade. The population is estimated at 24.69 million inhabitants (July 2014 CIA World Factbook) with a literacy rate of 56.1%. Fifty one percent of the population is aged between 15 and 64 (median 17 years)[85]. The capital city is Maputo with a population of 1.15 million (2011 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 GPD growth in 2013 was 7%, with agriculture representing 29%, industry 25% and services 46.4% (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). While the mobile sub-sector experienced growth rates with the introduction of competition, growth has slowed due to ineffective cost structures and insufficient infrastructure. Market penetration is below the African average, with 88,100 fixed phone lines in use and 8.108 million mobile phones (2012 CIA World Factbook). Internet penetration is quite low with 613,600 users in 2009 (CIA World Factbook). During 2013 the Government initiated a revision of the 2004 Telecommunications Act to support the development of infrastructure and greater competition.

[85] CIA Factbook

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There are 2 public universities, 8 public Higher Education Institutions, 10 private Universities and 22 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 provide 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 of which other members are Ebale (DRC), Ethernet (Ethiopia), KENET (Kenya), MAREN (Malawi), Rwednet (Rwanda), SomaliREN (Somalia), SUIN (Sudan), TENET (South Africa), TERNET (Tanzania), RENU (Uganda) and ZAMREN (Zambia). MoRENET is a partner in the Africa Connect project[86] which aims to improve connectivity for research and education within Sub-Saharan Africa by providing 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 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

[86] http://www.africaconnect.eu

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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 has been drafted and is being considered by Cabinet.

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) and Digital Divide (Provincial Digital Resource Centres, Multimedia Community Centres Programme).

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 were 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 expaned connectivity to the districts aiming to cover all of the 128 existing districts in Mozambique.

Funding: Italian Government, World Bank and Government of Mozambique, and implemented by the National ICT Institute (INTIC) (formally the ICT Policy Implementation Unit UTICT).

Geographic scope: Government agencies at national level

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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 being developed and at this stage forms are being added through which citizens can access the services provided, taking in that way the Mozambican steps towards eGovernment a few steps further.

Funding: Italian Government through the GovNET Project described above

Geographic scope: Government agencies at national level

11.3.3 Human Capacity Building

One of the biggest constraints that were identified during the process of drafting the ICT Policy, its implementation strategy and eGovernment Strategy was the lack of qualified human resources that could maintain the system, equipment and infrastructure that could be put in place. To overcome this, a number of ICT capacity building programs are being implemented in the government institutions at all levels. The programs implemented are aimed at providing the necessary skills to use designed applications, administrate networks, manage and design data bases and web pages as well as produce word documents, worksheets, presentations, send and receive electronic messages, search for information on the Internet and produce and content and applications.

Funding: Italian Government through the GovNet Project, World Bank through MEGCIP project and UNPD

Geographic scope: National.

11.3.4 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.

This project also demonstrates that government transactions such as G2G (government-to-government), G2B (government-to-business) and G2C (government-to-citizen) can be done more effective and efficient when availed electronically so long as all the security mechanisms are taken. This project is being implemented by the Ministry of Finance, through the Development Centre of Financial Information Systems (CEDSIF).

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Funding: World Bank

Geographic scope: Government agencies at national level

11.3.5 Mozambique eGovernment Communication Infrastructure Project (MEGCIP) (2010 – 2014)

MEGCIP aims to support the Government of Mozambique efforts to lower communication costs by using international capacity to extend the geographic reach of the broadband networks and contribute in improving the efficiency and transparency through e-Government applications. This project is hosted at the Ministry of Science and Technology and consists of components focused on communication infrastructure, policy and regulation, eGovernment applications and institutional capacity building. Different parts of the project components are implemented by the Ministry of Science and Technology, National ICT Institute (INTIC), The Ministry of Transport and Communication and the Mozambican National Institute of Communications (INCM).

Funding: World Bank, with an implementation time frame of 2010 to 2015 with a total budget of $30,000,000 USD

Geographic scope: National

11.3.6 ICT Legal and Regulatory Framework

A proper development and implementation of ICT initiatives requires a legal, regulatory frame work, which also protects against different forms of electronic abuse and crime. Thus, the Government is defining a set of regulations to ensure a balanced and equitable development of ICT infrastructure, adoption of solutions and cryptographic codes less susceptible to violation, combat the violation of citizens' rights and attempts against public order and social and cultural values, especially pornography, abuse and violence against women and children via the Internet. To realize this, the Electronic Transaction Law was prepared and other set of regulations will be also put in place.

Funding: World Bank through MEGCIP project also described above

Geographic scope: National

11.3.7 Mobile ICT Unit

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: UNDP and Italian Government

Geographic scope: Districts

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11.3.8 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. The first CPRDs were established in 2004 in the Provinces of Inhambane and Tete by the ICT Policy Implementation Unit (UTICT), 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 have being 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 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

11.3.9 National System of Civil Registration (SINAREC)

Mozambique does not have a central registration system to register its population from birth and citizens do not have a unique personal number. To the contrary there are different ID Cards/documents that are issued independently by different ministries, such as ID Card, Election Card, Military Card, Health Card, Driver License Card, Passports and other identification documents.

This project is one of the fundamental corner stones in Mozambique's national eGovernance strategy. It 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.

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The project activities that will account for the creation of a legal framework for full-scale system, capacity building will require further funding to be secured.

Partners: Ministry of Science and Technology, Ministry of Justice, the Mozambican International Bank and the Swedish Tax Agency

11.3.10 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 [What funding was allocated over what time period?]

Geographic scope: National

11.3.11 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 has being developed by Semlex, a Belgian company that invested 50 million dollars in setting up the new ID system and passport. Semlex aims to recover this investment from the sale of the ID cards, which will cost 180 meticais (about 6.6 US dollars) each, while the new passports cost 3,000 MT, or 3,750 MT if the document needs to be issued within two days. This is quite expensive when compared to the current statutory minimum wage for agricultural workers (1,486 MT) and workers in financial services (2,745 MT). The old ID Cards and passports remain valid until they expire.

11.3.12 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

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11.3.13 Multimedia Community Centres (MCC) Programme

This program aims at providing a means by which the community have 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 but with a contribution of different institutions such as 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

11.3.14 SchoolNet Mozambique

SchoolNet Mozambique is a nationwide network of professional educators and schools working to make the Mozambique educational system competitive by preparing in-school youth for Internet connectivity and technology. The network aims to enhance learning opportunities for students, teachers, and the surrounding community via the Internet. SchoolNet is also seen as a way to prepare Mozambican students for work in the Global Information Society.

Students and teachers in the SchoolNet network use the Internet as a learning tool. Mozambican students have participated in Internet-based exchanges such as the Global Environment Youth Convention and the Math Olympics.

The immediate motivation for the deployment of this network was to share a single Internet connection and therefore reduce overall monthly costs in order to assure a long-term sustainability. However, once such a network is deployed the potential to include other services, that would not be possible or at least viable if each school had just its own separate network, is tremendous, for example Voice over IP, shared Mail, Proxy and WEB servers, shared applications like virtual library, just to name a few. On the other hand, once in place and functioning, such a network can easily grow just by having more schools connected to this initial backbone. It a firm conviction of the Ministry of Education that, using the wireless technology implemented in this first phase the network could easily grow up to at least 100kms from its actual focus point which means probably a few tens of schools for the case of Inhambane province. The other major goal of this project is to develop a solution that once tested can easily be replicated in other provinces all over the country.

Geographic scope: National

11.3.15 Licensing and Management of Mineral Resources

The Ministry for Mineral Resources in Mozambique has adopted FlexiCadastre, an enterprise scale land management solution using Spatial Dimension to deliver sustainable solutions that optimise land related business processes, minimise risk, provide compliance and oversight functions and

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integrate seamlessly with other enterprise systems. The FlexiCadastre solution uses a business rule and workflow-centric approach to facilitate the efficient administration of mineral rights and contracts in multiple global jurisdictions. It provides a web portal for data management and reporting, advanced task management, configurable business logic, best of breed GIS technologies and innovative concepts.

11.3.16 Environmental Management and Information System for Mining Sector

The purpose of the EMIS is to facilitate environmental procedures in the mining sector to ensure the availability of technical information and data for environmental monitoring and environmental auditing store, manage and reference documents. Ideally these should be digital, store and report on environmental surveys, on samples and on analyses performed. This management system has the benefit of extending the existing Cadastre System to include Environmental procedures and actions, it also requires:

- The Environmental requirements are closely related with the application, granting and renewal of Mineral Title
- The Mining Cadastre System has a comprehensive GIS interface utilizing ArcGIS
- Integrating the two systems would allow cost savings in terms of existing hardware infrastructure
- Integrating the two systems would allow for a single system to support and maintain
- Integrating the two systems would allow for resource pooling between the Cadastre and Environmental departments

Geographic scope: National

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 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), FAO and other NGOs

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

Institution	Location	Total Students	ICT/Engineering Department(s)	ICT/Engineering Teaching Staff	Undergraduate Students	Post-Graduate (Masters, PhD)
UEM	Maputo	4,000	Electronic Engineering and Informatics	20	319	259
UP	Maputo	2,500	Informatics	6	40	
ISCTEM	Maputo	2,000	Informatics, Engineering	10	280	20
UCM	Maputo	1,200	Informatics		48	
ESCN	Maputo		Engineering		223	
ISUTC	Maputo		Engineering		142	
UTM	Maputo		Engineering		100	

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

- **Eduardo Mondlane University** (UEM)[87]
  - 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

[87] http://www.uem.mz/

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- **Mozambican ICT Institute** (MICTI)
  - Research areas include: ICT, Environment, Science & Engineering Education / Training, Manufacturing, Energy
- **Catholic University** (UC)[88]
  - Depts include: Faculty of Engineering: Department of Information Technology
  - Research areas include: Sustainable Technological Development, Environment, Tourism, Social Education
- **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)[89]
  - 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)** [90]
  - Research activities related to the use of ICT and Entrepreneurship for poverty alleviation
- **Mozambican Higher Institute of Science and Technology** (ISCTEM)[91]

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:

[88] http://www.ucm.ac.mz/
[89] http://www.up.ac.mz
[90] http://www.ustm.ac.mz/
[91] http://www.isctem.ac.mz/

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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
eAgriculture	Crop Management; Agri-food based applications	IIAM (Agricultural Research Institute); Eduardo Mondlane University
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
eGovernment	Public Service Delivery, mGovernment services	INTIC

11.4.4 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
Future Internet	**INTIC:** Networks, Wireless Communication **CIUEM:** Networks, Software and Services, Wireless Communication
Content Technologies & Information Management	**INDE:** Technologies for Language, Learning, Digital Preservation **Pedagogical University:** Technology-enhanced Learning **INTIC**: Content & Information Management

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**

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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)
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 projects, securing research funding of over **€3.36 million** under FP7.

The level of research maturity in 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) which is investing in funding national research programmes.

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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 2014 was estimated at 2.19 million inhabitants with a literacy rate of 88.8%[92]. Sixty-three 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 325,858 (2011, Namibia Census Report). Namibia is multi-cultural with English as the official language, and 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 7% of GDP. Other activities include Industry (29.4%) and Services (62.7%) estimate 2012. 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) there were 181,696 fixed phone subscribers, 2.3 million mobile phone subscribers and 1.2 million Internet Users in June 2013.

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, which facilitates access to advanced technologies, products, applications and services. 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 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

[92] CIA World FactBook

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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 two cellular operators MTC 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 (WIXP) in collaboration with the African Union Commission through the African Internet Exchange System (AXIS) Initiative.

Namibia has one public University with over 16,846 students, one public Polytechnic with over 13,130 students (2013), 46 vocational training centres and skills development centres, one private University with 8,300 students (2013) 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 that Namibia should be a knowledge-based economy by 2030. In so doing, the government aims to establish ICT as the critical sector for the Economic Development of the country by 2030. It envisages 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

As its mission 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.

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- 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.

Higher Education Institutions are the major ICT hub for servers, computers, e-learning media system and Internet access through narrowband and broadband technologies offered by Telecom of Namibia, MTC, and other service providers, including Xnet. For example, the Polytechnic of Namibia has over 2,200 PCs and Laptops located in more than 35 labs and well as in the library and offices, 259 laptops to be used by students and staff and 120 servers.

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).

12.3.1 TECH /NA! , Namibia's ICT in Education Initiative

TECHN/NA!, Namibia's ICT in Education Initiative is 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 fulfils Namibia ambition to become a knowledge-based society by 2030. It is a sub-programme under ETSIP.

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Activities include 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 is funded by the Namibian government, with local and international support.

Geographic coverage: National

12.3.2 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. That means that patients need not carry medical passports or treatment records while visiting any government hospital for treatment. The system will replace all manual procedures and systems in the hospital, reducing strain on medical staff. By the end of 2011, 800 end users in two hospitals in Windhoek were trained on the system.

The system is implemented at Windhoek Central, Katutura and Oshakati hospital. There have been delays with regard to the rollout of the system to other state hospitals. This is due to non-availability of the required equipment and the network infrastructure in those hospitals. However, the Ministry has now acquired quite a number of equipment and has also entered into an agreement with Telecom Namibia to establish the required network infrastructure. The work in this regard has already commenced. Budget constraints is one of the factors affecting the full establishment of the system.

Funding sources: This programme is funded by the Namibian government, with local and international support

12.3.3 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 has availed 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.

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Telecom has so far equipped the centre with 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.

Apart from Telecom's IT specialists forming part of the team that will mould students at the facility, the company has also invited its competitor, MTC and power utilities Nampower and Nampost, to come on board.

Funding sources: This programme is funded by Telecom Namibia and University of Namibia

12.3.4 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. The consultants assigned to the project are from SILNAM IT Solutions. The first phase of the project was to assess the readiness of the Government of Namibia to embark on the e-Governance journey. To accomplish that, the consultant and the project team consulted with the government Offices, Ministries and Agencies (OMAs), businesses and communities as well as conducting surveys through questionnaires.

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.

The following are sub-projects under the e-Governance project;

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1. Improve government ICT infrastructure

The aim of the project is to improve the Government ICT infrastructure by creating an enabling environment for the implementation of all other e-Government projects and systems. To expand the GRN Intranet Network to include all the thirteen Regions to enable access to GRN Intranet Network 24 hours a day, 7 days a week.

2. Build Skilled ICT Resources

The main objective of this project is to build a skilled ICT Human Resources in the Namibian Public Service with a view to tap maximum benefit from existing computers by fully utilizing the products invested into by the GRN; accelerate the implementation of eGovernance Policy by promoting access and usage of the GRN Intranet /Internet.

3. Government Portal

The goal of the project is to facilitate the consumer transition from ‘in-line’ to ‘on-line' by providing a single point of access to information and services organized according to the interests and needs of its consumers, permitting anytime, anyplace and anywhere access; This is in accordance with NDP 3 Programme 4: Implement five phases of e-Governance which calls for efficient provision of e-Services.

4. Electronic Documents and records management system project

The objective of the project is to ensure a risk-free records and archival system is set up in a sustainable electronic documents and records management environment, in line with the National Archives Act (Act number 12 of 1992) and many other related statutory provisions. The EDRMS implementation started in 2009. The Division is currently working with 24 Offices, Ministries and Agencies (OMAs). 9 of them are fully using the system already and 15 of them are busy completing their activities and are about to finish very soon. The Division is currently left with 10 OMAs based in Windhoek with 13 at Regional Councils.

The project aims to lead to the improvement of record and archives management in the public services, where this is increasing usage of electronic data and information system in the creation of its knowledge management and supporting decision–making mechanisms.

12.3.5 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.

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12.3.6 Electronic Voting Machines (EVMs)

The Electoral Commission of Namibia introduced the Electronic Voting system (EVS) for the 2014 Presidential and National Assembly Elections.

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.

There are two particularly relevant research areas for cooperation between Namibian research organisations and their peers in Europe. One key research area is Digital Libraries and digital preservation (Indigenous Knowledge), Technology Enhanced Learning and Digital Content. The other key area is ICT for Environmental Sustainability (Services & Climate Change Adaptation) and Energy Efficiency (specifically related to the climate and landscape of the country).

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	-
Polytechnic of Namibia	Windhoek	11,000	School of Information Technology	10	Masters in Information Technology
International University of Management	Windhoek	6,000	Information Technology and Systems Management	6	-

Research in Namibia is predominately carried out within the two main Higher Education Institutions:

- **University of Namibia**[93]
  - 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;

[93] http://www.unam.na/

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- 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), Zoobenthes Survey in the Walvis Bay (Walvis Bay Municipality funded project

- **Polytechnic of Namibia**[94]
  - Depts include: School of Information Technology; School of Health and Applied Science; School of Engineering
  - ICT Research Groups include: ICT for Development: Living Lab; Community Indigenous Knowledge Management System; Mobile Future Lab for Research; Namibia Business Innovation Centre
  - 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; 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

[94] http://www.polytechnic.edu.na/

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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

12.4.3 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
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); Polytechnic of Namibia (School of Health and Applied Science); Ministry of Health
eAgriculture	Mobile Applications for farmers - animal tracking, tips on livestock and crop production	University of Namibia (Faculty of Agriculture and Natural Resources); Polytechnic of Namibia (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; Polytechnic of Namibia
eGovernment	Public Service Delivery	University of Namibia; Polytechnic of Namibia

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12.4.4 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
Future Internet	**Polytechnic of Namibia (School of Information Technology):** Cloud Computing, Wireless Communication, Mobile Sensor Data Processing
Content Technologies & Information Management	**Polytechnic of Namibia (School of Information Technology):** Digital Preservation, Technology-enhanced Learning, Mobile Learning
Robotics	**University of Namibia (SANUMARC):** Aerosol robotic network group

Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	**University of Namibia (Faculty of Health Sciences):** Malaria **Polytechnic of Namibia (School of Health and Applied Sciences):** Health and Medical Sciences Research
Food Security, Sustainable Agriculture	**University of Namibia (Faculty of Agriculture and Natural Resources):** Crops, Fisheries Management **Polytechnic of Namibia (School of Natural Resources and Tourism):** Ecosystems services and biodiversity, Land, Agriculture, Water
Energy	**Polytechnic of Namibia (School of Engineering):** Renewable Energy **Polytechnic of Namibia (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 **Polytechnic of Namibia (School of Engineering):** Water Resource Management, Mining Sustainability and Environmental Impact
Inclusive, Innovative and Reflective Societies	**Polytechnic of Namibia (School of Information Technology):** Indigenous Knowledge in relation to Cultural Resources **University of Namibia:** eGovernance
Secure Societies	**Polytechnic of Namibia (School of Information Technology):** Trustworthy ICT

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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 building a track record in collaborative research through participation in **11** FP7 projects. 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 Polytechnic of Namibia 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. Eight out of 30 projects were funded for the year 2013/14 in the field of ICT.

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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 2014 was estimated at 13.6 million inhabitants, with a literacy rate of 49.7% (CIA World Factbook). Fifty four 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 3.035 million (2011 CIA World Factbook). 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, 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 30 September 2014 there were 317,653 fixed phone lines (346,980 September 2013) and 14.35 million phones (12.72 million in September 2013) as at 30 September 2014. There were 6.675 million Internet subscribers as at 30 September 2014 compared with 1.429 million in September 2013.

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.

There are five public Universities, seven private Universities, five public Institutes or Schools of Higher Education and 141 private Higher Education Institutions.

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13.2 ICT Background

One of the objectives clearly articulated by the Government is 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.

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), Digital Divide (Multimedia Community Centres Programme, Senegal Observatory on Information Systems, Networks and Info highways) Research (Centre de Recherche et d'Essai Programme, Scan ICT project), eInfrastructures (Grid Computing project, Brain Gain Initiative, Education and Research Network, Migration from Analogue to Digital Broadcasting project), Entrepreneurship (CTIC Dakar ICT Incubator) and eEducation (Virtual University of Senegal enrolled more than 2,000 students in 2013 -2014).

13.3.1 Legal and Institutional Framework

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

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- 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.

13.3.2 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 11 regions
- Interconnection of universities and research centres
- Data centre building

Funding: Senegal, China (intranet), Korea (wimax), France (demarches administratives)

Geographic coverage: National

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13.3.3 Universal Service Fund: Consider Internet and telephony as integral part of a universal service

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

13.3.4 Multimedia Community Centres (MCC) Programme

The MCC project aimed to develop a network of 20 MCCs in Senegal over two years and the main objectives are to:

- Reduce the digital divide;
- Facilitate access and appropriation of ICTs by communities;
- Reduce poverty by enabling people to solve development problems they face;
- Strengthen the capacity of communities

As at December 2013, 30 community centres are now installed through the country.

Implemented by the ICT Ministry with the cooperation of UNESCO

Geographic coverage: National

13.3.5 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

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As at October 2014, 17 research centres are already installed and ten more are due to be installed during 2015.

Implemented by the Ministry in charge of Scientific Research & Higher Education[95]

Funding source: Government of Senegal

Geographic coverage: National

13.3.6 Grid Computing project

With support from HP and UNESCO, the University Cheikh Anta Diop de Dakar (UCAD) initiated a project of grid computing in 2007. The project aimed to find solutions to the brain drain that is crippling Africa in the scientific conquest. The project targeted university laboratories and research centres. It contributes to improve the capacity of technical and scientific teams for the control of grid computing.

Funding source: HP and UNESCO

Geographic coverage: National

13.3.7 Brain Gain Initiative

This project aimed to set up a distributed socio-economic infrastructure for a knowledge-based development approach (Gaston Berger University).

In early 2009, UNESCO and HP agreed to extend the African pilot to some 100 higher education institutions in Africa and the Arab States region by 2011. Through the use of distributed computing, UNESCO, HP and other partners planed to create the first pan-regional University network and help reduce the number of skilled workers, scientists, academics and researchers that leave these regions.

Innovative technology and funding support allowed participating universities to re-establish links between researchers who have stayed in their countries and those living abroad, connect academics to international peers, research networks and funding opportunities. Faculties and students at beneficiary universities were able to work on innovative education projects with other institutions in their regions and around the world.

Funding source: HP and UNESCO

Geographic coverage: Regional

13.3.8 Education and Research Network (SnRER) Initiative

The main goal of SnRER is to build a national and regional academic infrastructure to:

- Support research and science collaboration;

[95] www.recherche.gouv.sn

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- 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. As at December 2013, the five public universities are in the process of being interconnected via optical fibre in collaboration with SONATEL.

All Public University Campuses are connected by free Wifi Internet access. Pedagogical campus will soon have a bandwidth of 2 x 150MB.

Geographic coverage and time frame: National/regional, ongoing project

13.3.9 Migration from Analogue to Digital Broadcasting Project

A national committee for the migration from analogue to digital broadcasting was established in August 2010. It is under the authority of the Minister of Communications and Telecommunications.

The committee's mission is to guide, coordinate and control the actions needed to ensure the passage of the audiovisual sector to digital.

It is composed of state representatives, regulatory authorities in the audiovisual and telecommunications companies in the audiovisual sector public and private operators of telecommunications services and ICT, professional organizations, etc.

The national committee consists of a coordinating committee and specialized committees that are responsible for providing solutions to legal, technical, commercial and related content and audiovisual programs.

Geographic scope and time frame: National; ongoing.

13.3.10 Senegal Observatory on Information Systems, Networks and Info highways (OSIRIS)[96]

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.

[96] www.osiris.sn

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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.

13.3.11 CTIC Dakar: An ICT Incubator[97]

CTIC Dakar assists 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 opened on 1st March 2011 and the official launch ceremony took place April 19, 2011.

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.

13.3.12 Women and Ecommerce project

The objective throughout the Women and E-commerce project is to promote greater integration of women including women in business to domestic, regional, and global in many ways by facilitating them to:

- Participate in the development of their countries in a more competitive and with greater facility;
- Find real information and useful for their activities;
- Communicate with each other and develop barter and trade in goods and services,
- Become known internationally and to be in contact with potential partners;
- Establish a circuit Solidarity trade;
- To sell their products in most competitive markets;
- To share best practices and their constraints.

[97] www.cticdakar.sn

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- Reduce intermediate
- To have more information to facilitate innovation and technological advance.

Implementing department: Ministry of Family and Women's Organisations

Geographic scope and time frame: National; ongoing.

13.3.13 National Action Plan of Resolution 70 of the International Telecommunication Union (ITU)

The plan is structured around a fund of the Employment of girls in ICT and is part of the program initiated by the government to bridge the gap that separates us from other countries in the field of ICT.

Implementing department: Ministry in charge of ICT

Geographic scope and time frame: National; ongoing.

13.3.14 E-ICT project[98]: 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

13.3.15 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

[98] www.e-tic.net

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Implementing department: UNRISD

Geographic scope and time frame: National; ongoing.

13.3.16 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.

13.3.17 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. Teaching commenced in February 2014 and over 2,000 students enrolled for the academic year.

Geographic scope and time frame: National; ongoing.

13.4 National ICT Research Capacity and Priorities for Cooperation

Senegal is currently developing a Science, Technology and Innovation Plan with the assistance of UNESCO. At present there are no formal national ICT research priorities defined. However, there are initiatives initiated by researchers. Among them, include the National Symposium on Research in Computer Science and its Applications (NCRI)[99]. NCRI is a framework for meetings between scientists and researchers from around the world.

The primary objective of the NCRI is to provide opportunity to the IT community (researchers, teachers and industry) with an interest in the areas of networking and computer services, applications and distributed systems, telecommunication networks, Semantic Web, to meet annually to exchange and publish the latest results of their work. NCRI 2012 is seeking papers that deal with all matters relating to development of communication protocols, networks and services:

- Networks and Distributed Systems
- Multi-agent systems and complex systems
- Management of large-scale data
- Knowledge extraction, data mining, Web mining

[99] cnria.cci.ucad.sn

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- Semantic Web, Web data, Web 2.0, Web 3.0
- Image Processing

13.4.1 National Research Capacity

Senegal has seven public institutions of higher education:

- Université Cheikh Anta de Dakar[100]
- Université Gaston Berger de Saint-Louis[101]
- Université de Thiès[102]
- Université Alioune DIOP de Bambey[103]
- Université Assane Seck de Ziguinchor[104]
- Université Virtuelle du Sénégal
- Ecole Polytechnique de Thiès[105]

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

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)

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:

[100] http://www.ucad.sn/
[101] http://www.ugb.sn/
[102] http://www.univ-thies.sn
[103] http://www.bambey.univ.sn/
[104] http://www.univ-zig.sn/
[105] http://ept.sn/

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Thematic Areas	Partners include
eHealth	Université Gaston Berger; Université Cheikh Anta Diop
Environment	Université Cheikh Anta Diop; Ecole Polytechnique de Thiès

13.4.3 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
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 Superieure 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 Raw Materials	**Université Cheikh Anta Diop:** Water Management and Sensors **Ecole Polytechnique de Thiès:** Water Management **Ecole Superieure 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. 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.

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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 2011 Censes Report, South Africa has a population of 50.6 million, of which 3 million households have computers, 3 million households have access to satellite television, 10.8 million households have access to a television set, 12 million households have access to a cell phone and 14 million householders have access to the Internet. The literacy rate is estimated at 93% (2011). Pretoria, the capital city has a population of 1.501 million, Johannesburg 3.844 million, Durban 3.012 million and Cape Town 3.362 million (2011, CIA World Factbook).

South Africa is a middle-income emerging market with abundant natural resources, well-developed financial, legal, communications, energy 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. Economic growth has been steady and unprecedented ranging from 2.4% in 1999, to 4.9% in 2004 to 5.1% in 2007. GDP fell to 2% in 2009, increased again to 3.1% in 2011, 2.5% in 2012 and estimated of 2% for 2013.

South Africa has the world's 26th largest economy by GDP (Gross Domestic Product) and the world's 35th largest labour force. It is the economic powerhouse of the African continent, and comprising 25% of the entire GDP of Africa.

South Africa spends close to 10% of GDP on ICT goods and services of which most are imported. ICT Research and Development spend is 0.12% of GDP with overall Research and Development spend around 0.92% of GDP. Services consisted of 68.4% of GDP, industry 29% and agriculture 2.6% (est 2013 CIA World FactBook)

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In relation to Communications, according to 2012 figures (CIA World FactBook), there were 4.03 million fixed phone lines in use compared with 68.4 million mobile phones. There were 4.761 million Internet hosts (2012) and 4.42 million Internet users (2009).

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 andWest African Cable System landed at Yzerfontein.

South Africa has a vibrant Higher Education sector with more than 900,000 students enrolled in the 23 state-funded tertiary institutions (universities, Universities of Technology) and 87 private institutions of Higher Education (Census 2011). Two more Universities have been established since the census. There are currently 50 registered public FET Colleges, covering training from Grade 10 to 12 and career-orientated education and training[106].

14.2 ICT Background

The South African ICT sector is the largest on the African continent and the 20th biggest in the world. 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 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 IBM, Unisys, Microsoft, Intel, Systems Application Products (SAP), Dell, Novell and Compaq.

The ICT industry includes hardware, software, networking and related professional products and services. South Africa's ICT and electronics sectors are expected to continue showing strong growth in the future. Testing and piloting systems and applications are growing businesses in South Africa, with the diversity of the local market, first world know-how in business and a developing country environment making it an ideal test lab for new innovations.

ICT activities are fragmented across a number of government departments, research institutions, universities and the private sector.

There are 18 strategic integrated projects[107] lead by the Presidential Infrastructure Coordinating Commission to develop a single common Infrastructure plan that will be monitored and centrally driven and has objectives of skilling, industrialisation and R&D. SIP 15 and 16 are focused on ICT

[106] http://www.dhet.gov.za/EducationInstitutions/FetColleges/tabid/174/Default.aspx/FetColleges/tabid/174/Default.aspx
[107] http://www.info.gov.za/issues/national-development-plan/

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and related fields. SIP 15 “Expanding access to communication technologies” is focused on providing 100% broadband coverage to all households by 2020 by establishing core points of Presence (POP’s) in district municipalities and extending new Infraco fibre networks. The school connectivity rollout is focusing on approx. 27000 public schools. TV migration nationally from analogue to digital broadcasting is also included. SIP 16: “SKA & Meerkat” is focused on SKA as a global mega science project, building an advanced radio-telescope facility linked to research infrastructure and high speed ICT capacity. It is expected to be commissioned in 2026. (Meerkat is SA’s small version). SANReN is connected over 142 sites and benefiting over 450K students and has capacity of 10Gbsp.

The Department of Communications is responsible for the ICT Policy, which is currently under review lead by the ICT Policy Review Panel appointed by the Minister of Communications. The purpose of the review is to examine the policy and regulatory frameworks that impact on postal services, ICT, networks, infrastructure and frequency spectrum allocation and licensing. The Broadband Policy "South Africa Connect" was adopted in 2013. A National Cyber Security Policy Framework is in place.

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 was informed by the ICT RDI Strategy, which was developed and 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 strategy. It aims to improve economic competitiveness and the quality of life for South Africans.

The 2015 ICT vision is that: “South Africa is an inclusive information society where ICT-based innovation flourishes. Entrepreneurs from historically disadvantaged population groups, rural communities and the knowledge-intensive industry benefit and contribute to the well-being and quality of life of our citizens. South Africa has a strong national ICT brand that captures the vibrancy of an industry and research community striving for excellence, characterised by innovative approaches to local and global challenges, and recognised for its contribution to the economic growth and well-being of our people and region.”

In line with this vision the key ICT R&D and Innovation strategic objectives are:

- To develop focused and strengthened ICT research activities to achieve world-class research competencies in identified key S&T areas;
- To build a strong and robust ICT innovation environment, with an indigenous ICT sector that is competitive and growing; and
- To build advanced human capital (ICT skills base) for research and development, as well as the proliferation of ICT in other sectors of the economy.

The context for the National ICT RDI Strategy is based on the following:

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- The Internet economy contributes 2% to South Africa's GDP. This contribution is rising by c 0.1% per year and it is planned to reach 2.5% by 2016.
- Total spent by consumers, Small and Medium Enterprises (SMEs) and Government on products and services via the Internet as well as on Internet access and infrastructures is R59 billion
- The Internet economy will over time being approaching the size of the construction sector (estimated R120 billion in 2011), potentially becoming one of the new building blocks of the South African Economy.
- South Africa spends close to 10% of GDP on ICT goods and services, most of which are imported.
- South Africa ICT Sector in 2011 was R187 billion (estimate for 2020 is R250 billion).
- R&D Intensity of South Africa has stabilised at around 0.92% of GDP over the past few years but is still below the global norm of 2%.
- Between 2006 - 2010, South Africa produced 20 - 25 PhDs on average in ICT related fields of study
- Government, Universities and Science Councils have a keen interest in ICT R&D, but funding and current spending on ICT R&D is limited compared to other fields

Starting in early 2011, the Department of Science and Technology (DST) embarked on the process of reprioritising areas of ICT RDI funding and identifying new areas that have a significant potential to contribute to the growth of South African economy. This process was termed the *ICT Research and Development Implementation Roadmap Exercise*. Its purpose is to review the existing ICT RDI strategy; definition of new focus areas and interventions; new budget options and an improved understanding of the full ICT RDI landscape in South Africa. The exercise took stock of current ICT RDI capabilities and initiatives, analysed trends from a national and global perspective, and from this, identified future direction for the ICT RDI sector in South Africa.

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 South African ICT RDI ecosystem.

The ICT RDI Innovation Roadmap was adopted in early 2013 as a plan and set of actions to guide R&D investments over the next 10 years. In total, 63 technology themes and trends were identified and analysed throughout the process. 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)

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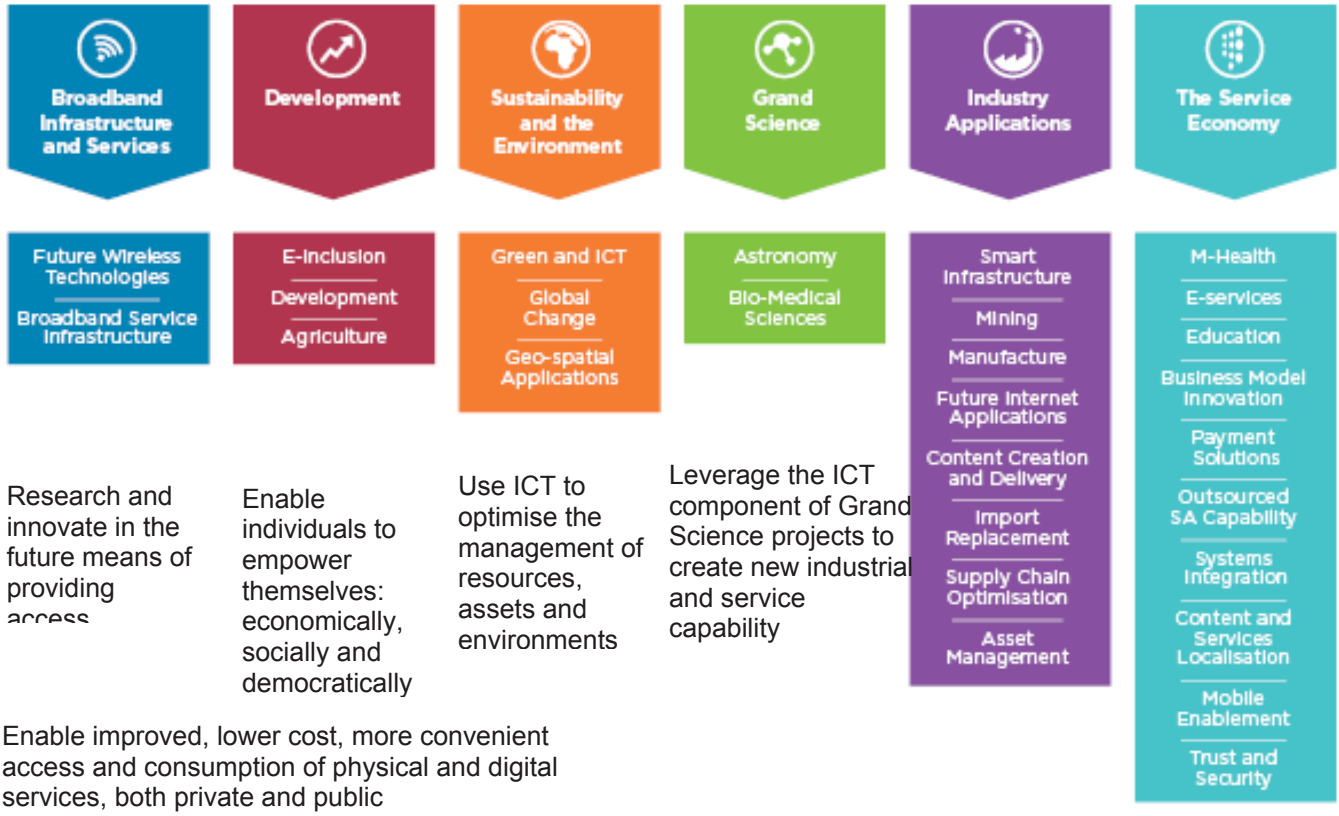
- Grand Science (Astronomy; Biomedical sciences)
- Industry Applications (Smart infrastructure; Mining, Manufacture; Future internet applications; Content creation and delivery; Import replacement; Supply chain optimisation; Asset management)
- The Service Economy (m-health; e-Services; e-Education; 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 will revolve on working around a partnership 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.

14.3 Current ICT Initiatives and projects

Some of the ICT Initiatives are currently ongoing at national level include the Broadband Policy Review Process, South African National Research Network & Tertiary Education and Research Network, Digital Terrestrial Television Migration, Square Kilometer Array, Schools Connectivity Project and Wireless Mesh Network Technology Demonstrator.

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14.3.1 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 139 sites. SANReN also supports the Square Kilometer Array and the South Africa Antarctic Research Programme. Approximately 400,000 students, academics and researchers presently benefit from the network with the target to research 10 million users. The next phase of SANReN will connect further sites and increase broadband network capacity.

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 provides Internet and related services to around 170 campuses of 55 institutions. 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).

Funding Sources: DST

14.3.2 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 being one of the countries signed the treaty and is working towards a digital migration. 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 timeframe for the start of switching off of the analogue signals is December 2013. After this date, the analogue signal will be switched off and no one in South Africa will be able to view digital TV without a Set Top Box. 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 has 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 5 million poorest TV owning households. The subsidy will be funded through the Universal Service and Access Fund (USAF).

Funding sources: Universal Service and Access Fund (USAF)

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Geographic coverage: National

14.3.3 The Square Kilometer Array

The Square Kilometre Array (SKA) will be a radio telescope. The majority of the SKA - the full dish array and the dense aperture array - will be built in Africa. The core - i.e. the region with the highest concentration of receivers - will be constructed in the Northern Cape Province, 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) will be built in Australia. South Africa has already demonstrated its excellent science and engineering skills by designing and starting to build the MeerKAT telescope – as a pathfinder to the SKA. The technology being 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 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 2024.

14.3.4 The Schools Connectivity Project and Wireless Mesh Network Technology Demonstrator

The DST, through the CSIR's Meraka Institute is leading the development of a technical plan to connect approximately 27,000 public schools. The project is jointly co-led by the Departments of Science and Technology, Basic Education and Communications.

In addition to the Schools Connectivity project, the DST has connected over 200 public schools to the Internet in the districts of Nkangala (Mpumalanga) and Sekhukhune (Limpopo) through the Wireless Mesh Network (WMN) technology, which is partly the output of R&D activity funded by the DST and conducted by the CSIR Meraka Institute. The WMN technology demonstrator project is funded through the Sector Budget Support grant provided by the European Commission.

14.4 National ICT Research Capacity and Priorities for Cooperation

14.4.1 National Priorities

Areas of research being undertaken within the Universities includes: Artificial Intelligence; Biomedical Technology; Broadband Communication and Wireless Networks; Control Systems; Enterprise Architecture; e-Services; FOSS; Gaming; Geographical Information Systems (GIS); Human Computer Interaction; Health Informatics; ICT and Education; ICT Governance; ICT4D; Image Processing and Vision Systems; Information Security; Information Systems; Internet Computing; Logistics; Mobile ICT; Multi-Modal Communication; Network Applications; Robotics; Signal Processing; Software Engineering; Speech Technology; Telecommunications and Virtual Reality and Graphics.

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14.4.2 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)
CSIR/Meraka Institute	Gauteng	Students at Meraka are registered with various Universities for their study Degrees	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	Over 27,000	Informatics and Design
Central University of Technology	Free State	Over 33,000	Computer Science and Informatics
Durban University of Technology	KwaZulu-Natal	Over 22,000	Electronics Engineering, Information Technology
Fort Hare University	Eastern Cape	Over 7,050	Computer Science, Information Systems
Nelson Mandela Metro University	Eastern Cape	Over 26,100	Electrical Engineering, School of Information and Communication Technology, Computer Science, Institute for ICT Advancement
North West University	North West	69,224	School of Mathematics and Physical Sciences; School of Electrical, Electronic, Information Systems and Computer Science; School of Information Technology
Rhodes University	Eastern Cape	6,000	Computer Science; Information Systems; Physics and Electronics
Stellenbosch University	Western Cape	27,823	Computer Science; Electrical and Electronics Engineering; Centre for Languages and Speech Technology
Tshwane University of Technology	Gauteng	60,000	Departments of Electrical Engineering, Computer Engineering, Computer Networks, Systems Development, Enterprise Application Development and ICT Management
UNISA (It is an Online and Distance Learning Institution)	Gauteng	350,000	Department of Electrical Engineering; Centre for Software Engineering; School of Computing
University of Cape Town	Western Cape	25,508	Computer Science; Information Systems; Electrical Engineering; Centre for Information Technology & National Development in Africa
University of Free State	Free State	Over 33,000	Computer Science and Informatics
University of Johannesburg	Gauteng	48,000	Academy of Computer Science and Software Engineering; Department of Electrical and Electronics Engineering Science
University of KwaZulu Natal	KwaZulu-Natal	Over 43,000	School of Mathematics, Statistics and Computer Science, School of Computer Engineering
University of Limpopo	Limpopo	Over 16,500	Department of Computer Science
University of Pretoria	Gauteng	Over 45,000	Departments of Computer Science, Informatics and Information Science. Departments of Systems Engineering, Electronic and Computer Engineering.

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University of Venda	Limpopo	Over 9,000	Department of Computer Science and Information Systems
University of Zululand	KwaZulu-Natal	Over 12,000	Department of Computer Science.
University of the Western Cape	Western Cape		
University of Witwatersrand	Gauteng	29,000	Department of Computer Science. Department of Electrical & Information Engineering.

South Africa has 25 institutions of Higher Education as well as research centres that have the human and infrastructural capacity to successfully participate in joint collaborative projects under Horizon 2020:

- **CSIR/Meraka Institute**[108]
  - 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;
- **University of Cape Town**[109]
  - Departments include: Department of Electrical Engineering; Computer Science and Information Systems and Centre for Information Technology & National Development in Africa
  - Research areas include: Radar Remote Sensing; Computation and Applied Mechanics; Broadband Networks & Applications; Digital Image Processing; Information for Community Oriented Municipal Services
- **University of Pretoria**[110]
  - 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**[111]
  - Departments include: Department of Electrical and Electronics Engineering Science; Academy of Computer Science and Software Engineering

[108] http://www.meraka.org.za
[109] http://www.uct.ac.za
[110] http://www.up.ac.za
[111] http://www.uj.ac.za/

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- Research areas include: Industrial Electronics Technology; Telecommunications and Stream Processing Research

- **University of KwaZulu Natal**[112]
  - 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**[113]
  - Departments include: Department of Electrical Engineering; Centre for Software Engineering; School of Computing
  - Research areas include: Image Control and Processing; Intelligent Systems; Parallel and Distributed Computer Architectures; Intelligent Agents; Electrical Systems and Wireless Communications

- **University of Witwatersrand**[114]
  - 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 Metro University**[115]
  - Departments include: Electrical Engineering; School of Information and Communication Technology, Computer Science; Institute for ICT Advancement
  - Research areas include: Human Language Technologies; Mobile Development Platforms;

- **Rhodes University**[116]
  - Departments include: Computer Science; Information Systems; Physics and Electronics
  - Research areas include: Cloud Computing; Mobile Development Platforms; Living Labs

- **Stellenbosch University**[117]
  - 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;

[112] http://www.ukzn.ac.za/
[113] http://www.unisa.ac.za
[114] http://www.cs.wits.ac.za
[115] http://www.nmmu.ac.za/
[116] http://www.cs.ru.ac.za
[117] http://www.eng.sun.ac.za/portal/page/portal/Engineering/Engineering_Home

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Search Applications; Software Engineering and Architectures; Visualisation; Simulation and Modelling; Internet of Things

- **University of the Western Cape**[118]
  - Research areas include: Human Language Technologies; Software Design; High Performance Computing
- **Cape Peninsula University of Technology**[119]
  - Departments include: Electrical, Electronic and Computer Engineering; Industrial & Systems Engineering; Information and Communications Technology Academy; Informatics and Design
  - Research areas include: Energy Harvesting; RFID; Simulation & Modelling; Games Engine; Localisation
- **Central University of Technology**[120]
  - Departments include: Department of Electrical, Electronic & Computer Engineering; Department of Information Technology
  - Research areas include: Voice over IP; Mobile Platforms
- **Durban University of Technology**[121]
  - 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**[122]
  - 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**[123]
  - Departments include: Department of Computer Science & Information Systems
  - Research areas include: Living Labs
- **North West University**[124]
  - 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**[125]

[118] http://www.uwc.ac.za/
[119] http://www.cput.ac.za/
[120] http://www.cut.ac.za/
[121] http://www.dut.ac.za
[122] http://www.tut.ac.za
[123] http://ufh.ac.za/
[124] http://www.nwu.ac.za

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- Departments include: Department of Computer Science and Informatics
- Research areas include Software Design

- **University of Limpopo**[126]
  - Departments include: Department of Computer Science
  - Research areas include: Software Design

- **University of Venda**[127]
  - 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**[128]
  - Departments include: Department of Computer Science; Department of Physics and Engineering
  - Research areas include: Image Processing; Enterprise Data Integration; Model Driven Development

- **Vaal University of Technology**[129]
  - 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**[130]
  - 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 an intention 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 to be important in the context of the ICT-39 Call:

[125] http://www.ufs.ac.za
[126] http://www.ul.ac.za/
[127] http://www.univen.ac.za
[128] http://www.uzulu.ac.za/
[129] http://www.vut.ac.za
[130] http://www.wsu.ac.za

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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	Nelson Mandela Metropolitan University; University of the Free State; Meraka Institute; Medical Research Council; University of Stellenbosch; University of Cape Town; Walter Sisulu University; Tshwane University of Technology
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; Meraka Institute; UCT Center for Education Technology
eAgriculture	Use of ICT to support enhanced agricultural production; Cloud Model for Agricultural sector; Integration of early warning systems into mobile platforms	University of Stellenbosch; Agricultural Research Council; University of Pretoria
eGovernment	Public Service Delivery; Optimisation of municipality systems; Smart Cities	University of Stellenbosch; Meraka Institute; Walter Sisulu University; University of Cape Town
Environment	Sensor technology to monitor water loss and quality; air quality; Smart electricity grids	University of Pretoria; University of Johannesburg
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; Meraka Institute

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14.4.4 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	**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. **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. **University of Johannesburg, Academy of Computer Science and Software Engineering:** Component-based embedding of Agent-enhancing characteristics in Agents and Multi-Agent systems. **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.
Advanced Computing	University of Cape Town, University of Western Cape, CSIR Meraka: High Performance Computing
Future Internet	**Council for Scientific and Industrial Research, 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. **University of Pretoria, SAChI**:Advanced sensor networks with focus on hardware, test-beds and implementation aspects. **University of Johannesburg, Academy of Computer Science and Software Engineering**: Services oriented architecture, Software as service, Cloud computing and Cybersecurity.
Content Technologies & Information Management	**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. **Witwatersrand University: School of Electrical and**

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	Information Engineering: Focus on Big Data (Medical Informatics) and Bioinformatics. **University of Pretoria, Department of Information Science**: Knowledge Management, Information Processes, Meta-context of Information. **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.
Robotics	**Council for Scientific and Industrial Research, Modelling and Digital Science**: Mobile intelligent, autonomous systems for areas of field robotics that promote intelligent behaviour such as in mining and other unstructured environments. **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. **Tshwane University of Technology, Department of Electrical Engineering:** Control, Image Processing and Machine Intelligence. **University of Pretoria, Department of Electrical, Electronic and Computer Engineering, SAChI**: Research is on computational intelligence, with a particular focus in computational swarm intelligence, learning from zero knowledge using competitive coevolution, and evolutionary algorithms. **University of Cape Town, Department of Electrical Engineering:** Control and Instrumentation, Image Processing and Vision Systems. **Cape Peninsula University of Technology, Electrical, Electronic and Computer Engineering**: Satellite systems engineering. **Nelson Mandela Metro 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.

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Horizon 2020 Societal Challenges	Institution, Relevant Dept and Research area
Health	**University of the Free State, School of Medicine:** High throughput biology, Bioinformatics/Computational Biology, Novel drug discovery and Advanced cloning systems. **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. **Medical Research Council: Medical Imaging Research Unit**: Medical imaging that specifically addresses the functional brain imaging, measurement of cancer cell topography; and characterising neuromuscular function. **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. **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. **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). **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. **University of Johannesburg, Department of Biochemistry:** Human Genetics and Infectious Diseases; Diabetes Therapeutic Research and Chromatin Research. **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. **Rhodes University, Natural Products and Medicinal Chemistry Research Group**: Research focus on function and medicinal chemistry of biologically active

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	natural products, medicinal plants and quality of herbal medicines, as well as the design and synthesis of new medicinal agents. **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 **Nelson Mandela Metropolitan University (NMMU):** Health informatics, ICT for disease management, Information security and interoperability standards **Walter Sisulu University(WSU):** Health informatics - Electronic Medical Records for Community Health Clinics **Tshwane University of Technology (TUT):** Medical Devices development, eHealth and mHealth platforms.
Energy	**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. **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. **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. **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. **Fort Hare University, Institute of Technology**: Research on Energy efficiency and the built environment, gasification of biomass, improvement of

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	the collection efficiency of the cyclone, thermal and chemical analysis of the gasification process. **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. **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. **Nelson Mandela Metro University**: Research and development on Strategic energy technologies for South Africa **University of Cape Town, Energy Research Center**: Energy efficiency, environmental and climate change, energy systems analysis and planning.
Food Security and Sustainable Agriculture	**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. **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. **Cape Peninsula University, 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. **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. **Institute of Wine Biotechnology:** Molecular and Metabolite Profiling of vines, Advanced chemical-analytical techniques in viticulture, oenology and biotechnology; Computational Biology and Biomathematics.

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	CSIR Biosciences: Key areas of focus are Natural product chemistry; Food science and technology; Natural product processing, and Indigenous knowledge and biodiversity management. **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. **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.
Inclusive, Innovative and Reflective Societies	**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 communities. **CSIR Meraka**: Human Languages Technologies, Speech-to-text technologies, wireless communication technologies for rural implementation.
Secure Societies	CSIR MDS, 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 having participated in more than 189 projects and securing more **€37.3 million** in research funding under FP7.

As part of the mapping of National ICT RDI capability undertaken as part of the ICT R&D Implementation Roadmap (2011), institutions used the following criteria to self-analyse capability:

	RDI Capability - Maturity		
	Faculty	Phd Students	Masters Students
0 Subcritical	Single faculty member	0 - 1	0 - 5
4 Emerging	Dedicated Professorship	1 - 5	5 - 10
7 Building	Research Chair or Centre of Excellence or Dedicated Professorship with small research group	5 - 10	10 - 20
10 Mature	Established Research Chair or Centre of Excellence with professors, senior lectures, lecturers and admin staff	>10	>20

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The following results were provided[131]

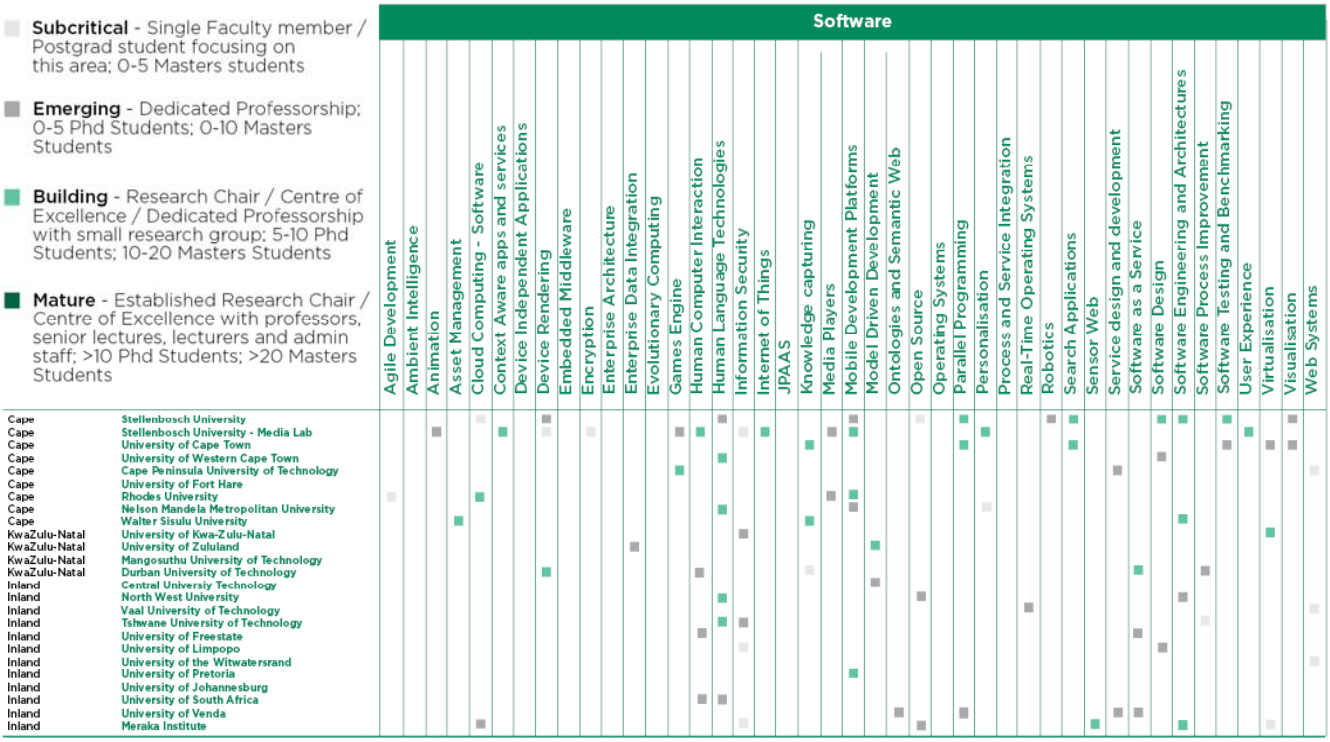

Figure: Strength and Maturity of ICT RDI Ecosystem at Universities

The ICT R&D Implementation Roadmap will be implemented over a period of ten years (2012 - 2022). With directed investment focused on system-level outputs, South Africa's ambitions in terms of outputs in the next 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)
- 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 will require 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 infrastructure, Partnership (PPP) and Collaboration, Research Chairs (National Research Fund), Centers of Competence (Technology Innovations Agency), seed funding and venture capital. The emerging to mature areas of R&D are shown in the Figure below:

[131] Full Capability Map available at http://www.meraka.org.za/ictroadmap/?q=node/761

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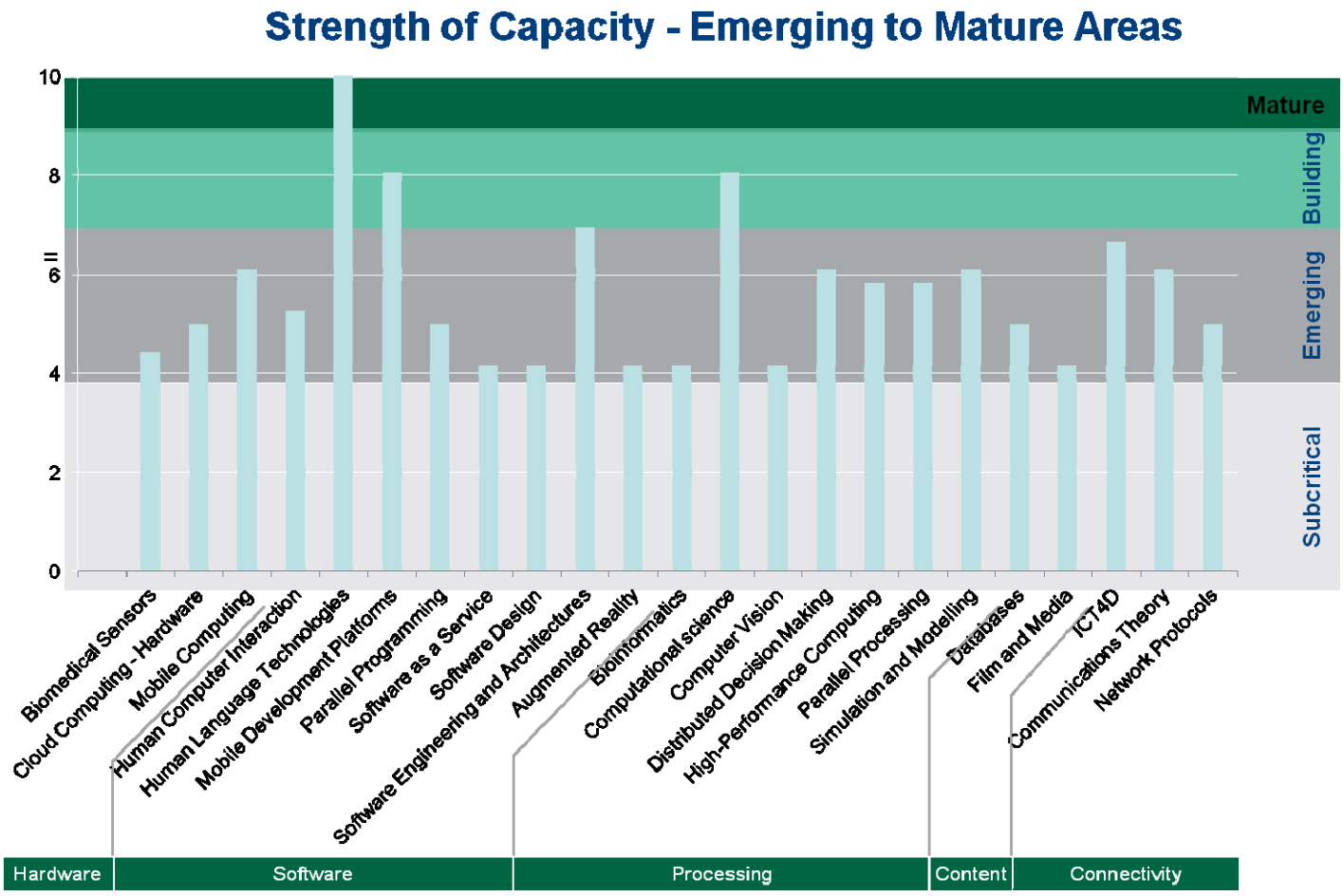

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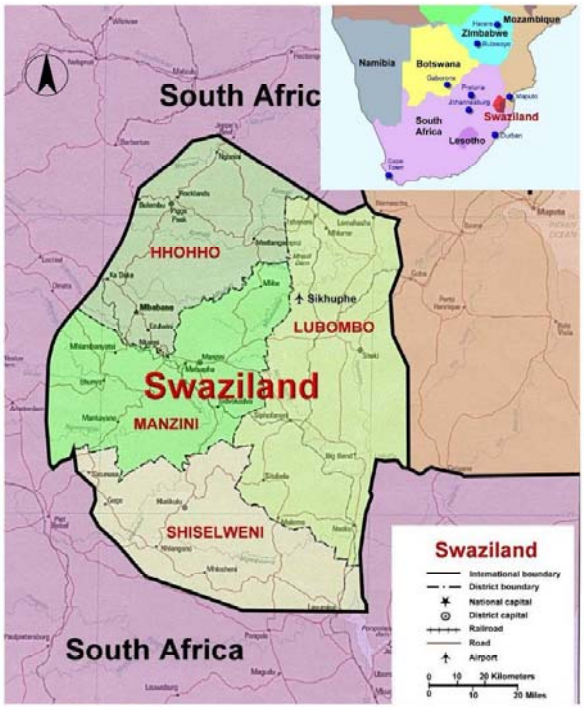
15. SWAZILAND

15.1 Introduction



The Kingdom of Swaziland is a landlocked country in Southern Africa, bordered by South Africa to the North, South and West and Mozambique to the East. Swaziland consists of four administrative districts namely 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 1.4 million inhabitants (est July 2014 CIA World FactBook) with a literacy rate of 87%. 59 percent of the total population is between 15 and 64 years of age. Mbabane, the capital city, has a population of 66,000 (2011, CIA World Factbook). The official languages are English and Siswati. Swaziland is classified as a low middle-income developing country with a GDP per capita of US$5,700 (2013 est).

In relation to Communications, Swaziland has two telecommunications service providers (Swaziland Posts and Telecommunication Corporation and MTN) with 80% mobile penetration. The country's backbone infrastructure is NGN and is connected to the SEACOM undersea cable through Maputo, Mozambique and EASSy undersea cable through Mthunzini South Africa for redundancy. Fibre optic is laid through out the country. There are four Internet providers including the government computer services department and 90,000 Internet users (representing 6.6% penetration). According to 2012 figures (CIA World FactBook), there were 48,600 fixed phone lines compared with 805,000 mobile phones. The national Internet Exchange Point (IXP) was put in place in April 2014. Free internet access is provided to schools and hospitals through ITU. Digital migration is due to be completed in July 2015.

There is one public university (the University of Swaziland) and three private institutions of Higher Education: The Southern Nazarene University, Limkokwing University and the Christian Medical University, which opened in August 2013.

15.2 ICT Background

The major policies in the ICT sector include:

- **The Swaziland Post and Telecommunications Corporation Act of 1983**

This is the Act of Parliament currently regulating the Communication Industry and is under the Ministry of information Communication and Technology. A new Bill, which will soon become Law is

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set to take over from this Act and liberalise the telecommunication industry by establishing an Independent Regulator for the regulation of the Industry. The Bill has passed through Parliament on its way to become Law (July 2013) and it is expected that it will become operational during early 2014.

- **ICT Policy 2004**

The ICT Policy is under the Ministry of Information Communication and Technology. 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:

- Formulating Information and Communication Technology (ICT) Policies that are in line with Government's social and economic development strategies;
- 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

- **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 Swaziland 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).*

- **Swaziland 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

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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 also seeks to transfer 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 is expected to 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

15.3 Current ICT Initiatives and projects

The Swaziland Government is currently developing a Science and Technology Park so that Swazis could have the opportunity to participate in the knowledge economy. This park would create a Special Economic Zone (SEZ) to facilitate FDI as well as R&D facilities to facilitate the 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 initial infrastructure. An area of 160 hectares is being developed for industries in the area of Biotechnology with funding from the Republic of China on Taiwan. It is anticipated that part of this development would be functional by 2015.

15.4 National ICT Research Capacity and Priorities for Cooperation

15.4.1 National Priorities

National Priorities include: eHealth, eAgriculture & Food Security, eInfrastructure, Environment and Entrepreneurship

15.4.2 National Research Capacity

There is one public university (the University of Swaziland) and three private institutions of Higher Education: The Southern Nazarene University, Limkokwing University and the Christian Medical University, which opened in August 2013. 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, six 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.

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15.4.3 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	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); Ministry of Health (Strategic Information Department - Research Unit); NGOs working in Health sector
eAgriculture	Early Warning Systems; Food Security; Livestock tracking; Drought resistance seeds	University of Swaziland (Department of Agricultural Research); Ministry of Agriculture (Department of Agriculture and extension); Swaziland Economic Policy Analysis Research Center; Swaziland Environmental Authority
eGovernment	Public Service Delivery	University of Swaziland (Department of Computer Information Systems); Ministry of ICT
Environment	Water Conservation	University of Swaziland, Swaziland Environmental Authority, Swaziland Water Services, Ministry of Natural Resources & Energy

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 eInfrastructure in place and encouraging institutions to develop research capacity.

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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 49.6 million (2014, CIA World Factbook) with a literacy rate of 67.8%. 52.2% of the total population is between 15 – 64 years of age. Dar is Salaam has a population of 3.5 million (2011, CIA World Factbook). Dodoma is the official capital and home to Tanzanian Parliament while the Government Ministries and major institutions and diplomatic missions are located 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 are currently under revision: the updated Science Technology and Innovation (STI) Policy will incorporate Entrepreneurship and the national ICT Policy of 2003 is under review as part of the development of a new implementation strategy.

7. Summary of Trend of Telecom Statistics

7.1 Subscriptions and Teledensity

	2005	2006	2007	2008	2009	2010	2011	2012	2013	June 2014
Fixed	*154,420*	*151,644*	*163,269*	*123,809*	*172,922*	*174,511*	*161,063*	176,367	**164,999**	150,073
Mobile	*2,963,737*	*5,614,922*	*8,322,857*	*13,006,793*	*17,469,486*	*20,983,853*	*25,666,455*	27,450,789	**27,442,823**	28,730,705
Total	***3,118,157***	***5,766,566***	***8,486,126***	***13,130,602***	***17,642,408***	***21,158,364***	***25,827,518***	**27,627,156**	**27,607,822**	28,880,778
Penetration	***10%***	***15%***	***21%***	***32%***	***43%***	***50%***	***59%***	**61%**	**61%**	**64%**

Fig7.1 Trend of Mobile and Fixed Subscription

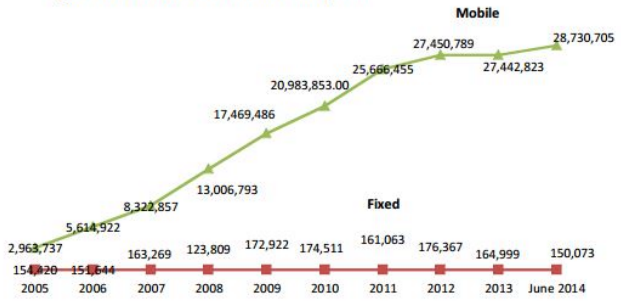
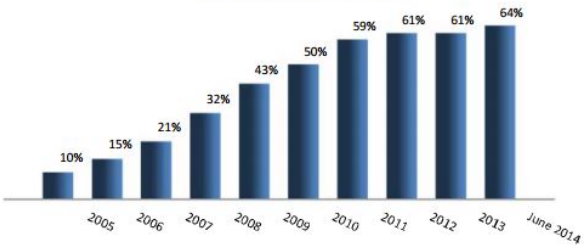


Fig7.2 Teledensity (Penetration)



In relation to Communications, according to the TCRA published statistics[132], there were 150,073 fixed lines and 28.73 million mobile subscribers, giving a teledensity penetration of 64% as at 30 June 2014. TCRA reported 9.3 million Internet users during 2013 compared with 7.5 million during

[132] TCRA Quarterly Telecom Statistics, Quarter 4 (June 2014) Report

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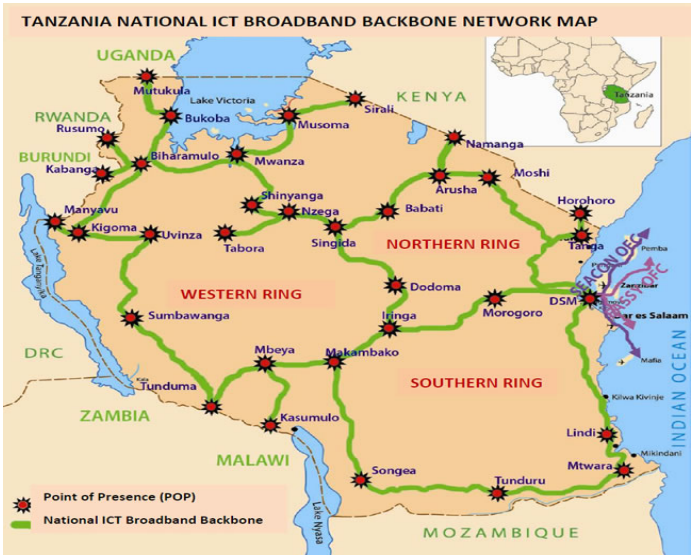
2012. Mobile money applications are very popular for paying water/electricity bills and sending or receiving funds, with M-Pesa provided by Vodacom Tanzania, Airtel Monday provided by Airtel and Easy-Pesa provided by Zantel.



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), which is now over 95% complete. 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. The Government has introduced a Universal Communication Fund to facilitate telecommunications in rural areas. National Internet Xchange Points (IXP) have been implemented since 2004 with funding from ITU. The national framework for Public Key Infrastructure (PKI) is being developed. There are more than 15 Tele-centres in place mostly funded by SIDA.

There are 11 public universities, 17 private universities and 26 private institutions of Higher Education.

16.1 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 National ICT Policy (2003) 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. Under the Bilateral agreement between the Government of Finland and the Government of Tanzania through the TANZICT[133] project the National ICT Policy of 2003 is under review as part of the development of a new implementation strategy.

The Government established the Ministry of Communication, Science and Technology in 2008, which among other tasks, is charged with the responsibility to create a conducive environment for investment, introduction and use of ICT in national development efforts and government operations.

Implementation of the National ICT Policy in Tanzania involves various stakeholders both public and private. With the Ministry of Communication, Science and technologies taking the lead, all

[133] http://tanzict.or.tz/

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government Ministries, Departments and Agencies (MDAs) are required to prepare relevant sector specific ICT strategies for the effective application of ICT. There are also development partners, and NGOs working with and facilitating MDAs in developing ICT strategies as well as carrying out specific projects toward implementation of ICT. The Tanzania Commission for Science and Technology plays a role in promoting ICT along with other technologies for development and also assists sector ministries in developing ICT strategies. In this regard, COSTECH championed the development of ICT strategies in the health, education, good governance particularly local government sectors.

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.

The cost of connectivity is very high in Tanzania, which creates barriers to the spread and use of the Internet, as a major vehicle for the transfer of data and access to information. Many higher education institutions use VSAT for bandwidth Internet. The Tanzania Education Research Network (TERNET) was established in 2008. Progress to date has been gradual and incremental. 128 HEIs and research institutions were identified for connection through the NREN, with 27 to be connected in Phase 1 of the Science Technology and Higher Education Program (STHEP). By December 2012, 14 Institutions (min 10Mbps) were connected to the Network Operations Centre (NoC) at COSTECH, which has a STM-1 line provided via SEACOM. TERNET is a member of the Ubuntunet Alliance and a participant in the AfricaConnect project to interconnect African NRENs' through cross-border fibre to facilitate regional exchange of research and education traffic. As part of the STHEP World Bank project, eLearning was piloted in 6 institutions, and Education Management Information System (EMIS) & E-libraries will be piloted in 16 institutions during 2014.

Under Tanzania Communications Regulatory Authority (TCRA), the Licensing Framework consists of Network Facilities, Network Services, Application Services and Content Service Providers. The Application Service license, which costs c. $2,000 per year, 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

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eventually support forty students. Applications for scholarships for 2014/2015 Academic year closed in August 2014.

16.1 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. KINU) and the Tanzania ICT Technology Park.

16.3.1 Science Technology and Higher Education Program (STHEP)

Science Technology and Higher Education Program (STHEP) is 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 is 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 has 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 is focusing 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.

Funding agency: World Bank, IDA credit, $100 million + further $15 million

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16.3.2 Tanzania National Research and Education Network (NREN)

Within STHEP, a major objective of component 2B is to set up TERNET[134] 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 is envisaged that over time the NREN will enable HEIs (Higher Education Institutions (HEIs) and Research Institutions to link to the Internet and to exchange information between institutions. It is 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.

ICT Infrastructure

The Government of the United Republic of Tanzania through the Ministry of Communication, 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, and is now 90% complete.

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 2014 18 Institutions will be connected with a minimum of 8Mbps connectivity.

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 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 pilots institutions were Tanzania National Parks (TANAPA), University of Dar es Salaam (UDSM), Muhimbili University of Health and Allied

[134] www.ternet.or.tz

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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).

Connectivity Arrangement

Initially the Open University of Tanzania (OUT), Dar es Salaam Institute of Technology (DIT), College of Business Education (CBE), Ardhi University (ARU), Herbart Kairuki Memorial University of Medicine, Institute of Transport, Mikocheni Agriculture Research Institute (MARI), Tanzania Industrial Research and Development Organization (TIRDO) were connected to the COSTECH NOC and directly linked with European GEANT2 through the Ubuntu Alliance. By December 2014 eighteen institutions were to be connected to the STM1 capacity providing a minimum of 8Mbps per institution.

Funding agency: World Bank

16.3.3 eHealth Strategy

The Ministry of Health and Social Welfare (MOHSW) is overseeing the development of an ICT strategy for guiding ICT applications in the sector. As part of ongoing health sector reforms, the Health Sector Strategic Plan III (HSSP III) has been developed to guide priority setting and deployment of resources in the health sector. While it is recognised that ICT has the potential to transform healthcare delivery, the national health sector has seen a fragmented landscape of ICT pilot projects and numerous data and Health Information System silos with inherent barriers to information sharing. The strategy aims to put better coordination in place to reduce duplication of effort, creation of new applications that are not interoperable and ineffective expenditure. It has been developed through a participatory process with stakeholders (workshops, survey, discuss groups, interviews) and a review of the World Health Organization (WHO) eHealth strategy development toolkit vision.

It is planned that by 2018, eHealth will provide a sustainable and efficient health system for citizens that guarantees patient information rights, integrity and confidentiality. Strategic areas of implementation identified include: eHealth Foundations, eHealth Solutions, Change Management and Governance structures to ensure good coordination and oversight of the national eHealth program.

Funding: from the Government of Tanzania, with the process facilitated by the International Institute for Communication and Development of The Netherlands.

Geographic scope: National covering all health facilities and agencies.

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16.3.5 TANZICT

TANZICT[135] is 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 and commenced in August 2011. It is 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 has 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 Workshop[136] 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 establish the grow their own technology-enabled businesses. Participants came together in Dar es Salaam for three 2.5 day workshops during December 2012, January 2013 and February 2013. The initial training was provided by Tina James and Jill Sawers of FEMTECH. Fifteen people were involved in the first course, which was provided free of charge in English and three people were trained as trainers.

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 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.

TANZICT and DTBi launch joint Call for Pre-Incubation and Incubation.

Funding: Government of Finland, 5 million euro (Sept 2011 – August 2015)

[135] http://tanzict.or.tz/

[136] http://www.ist-africa.org/home/files/ISTAfrica2012_LivingLabsWorkingGroupMeetingReport.pdf

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16.3.6 Dar Teknohama Business ICT Incubator (DTBI)

The Dar Teknohama Business Incubator (DTBi)[137] was set up in June 2011 under the Public Private Partnership between InfoDev and COSTECH with grant funding for the first two years to sub-vent set up costs and training. It is hosted by COSTECH as an Incubator to support local technology-driven companies as well as young entrepreneurs with high growth potential.

DTBi supports Pre-Incubation in co-operation with TANZICT, where the criteria are to have a disruptive business idea that is implement able or existing prototype, potential for scalability and ability to create greater social and economic impact. 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 quality 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 will support 10 scholarships per year for Masters students, an internship programme and employment opportunities.

Funding: InfoDev and COSTECH

16.3.7 KINU

KINU[138] was established in January 2012 as a social enterprise to provide an open space for Tanzania's tech community to foster co-creation, innovation and capacity building. Initial funding towards operational costs was secured from Indigo Trust and Google Africa. Other partners include SMILE and RAHA. In September 2012 SEACOM donated 30mb of Internet connectivity for one year to support KINU. Samsung provided equipment for a test lab.

KINU was formally launched as an Innovation Hub on 14 September 2012 with participation from H.E. Hon January Makamba, Deputy Minister of Communications, Science and Technology, entrepreneurs, industry, academia and media.

KINU provides co-working space, dedicated working space, facilities for application testing, workshops and training courses to support the tech community (start-ups, freelancers, SMEs and established companies). Regular training courses include CSS/Java, Cyber Security and Search

[137] http://www.teknohama.or.tz/
[138] http://www.kinu.co.tz/

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engine optimisation. Past events organised included information sessions on upcoming competitions (Google Apps Developer Challenge, African News Innovation Challenge, Vodacom AppsStar), funding opportunities (Savannah Fund), Mobile Monday meetings, Workshops on Open source software, Policy discussions on the ICT Policy and IP Laws, Google MapUp Events for Google Student Ambassadors and supporting participation in the Sanitation Hackathon.

To assist in developing skills, KINU started a Code Ninja Programme, which takes place on a Saturday every two months to test competencies in different programme languages as part of programming competitions that are judged by an automated judging system.

KINU supports a more active role for women and children in technology. KINU is co-organising a Girls Nights Out session for 2.5 hours once a month with TANZICT to support female entrepreneurs to leverage ICT in their businesses. An agreement has been reached with ISOC to provide training for women and to support 2 – 3 Tanzanian women to become ISOC certified trainers. A six-week Robotics Programme has been run for children (6 – 12 year olds) of members of the KINU community during 2013 and future coding programs for children are planned.

16.3.8 Tanzania ICT Technology Park

Over the next 5 years, 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. Following consultation with potential anchor tenants, basic infrastructure and facilities will be put in place. The ICT Park will be 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.

Preparation of a master plan for the Park is expected to be completed during 2014. Quality infrastructure and high Internet connectivity will be made available within the ICT park. The national backbone is directly connected to India and neighbouring countries. The park also aims to house a University for research and development in the long run.

Funding: SEACOM and COSTECH

16.4 National ICT Research Capacity and Priorities for Cooperation

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.

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- 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 Technologies[139], College of Engineering[140], University Computing Centre[141]
  - Research focus includes: Computer Engineering and Computer Science, Technology-enhanced Learning, Mobile Computing, Cyber Security
- **University of Dodoma**[142]
  - 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**[143]
  - 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**[144]

[139] http://www.sict.udsm.ac.tz/
[140] http://coet.udsm.ac.tz/
[141] http://www.ucc.co.tz/
[142] http://www.udom.ac.tz
[143] http://www.dit.ac.tz/
[144] http://www.ifm.ac.tz/

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- 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**[145]
  - 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**
  - 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 Technology[146]
- **Open University of Tanzania**[147]
  - Research focus includes: Environmental Issues; Agriculture & Food Security, Technology-enhanced Learning, ICT, Cyber Security, Health
- **Ifakara Health Institute**[148]
  - Research focus includes: Health Sciences, eHealth, Health Information Systems
- **Muhimbili University of Health Sciences**[149]
  - Research focus includes: Health Sciences, Health Informatics, Technology-enhanced Learning in the Health domain
- **Sokoine University of Agriculture**[150]

[145] http://www.nm-aist.ac.tz/
[146] http://www.aru.ac.tz/cat.php?id=25
[147] http://www.out.ac.tz/
[148] http://www.ihi.or.tz/
[149] http://www.muchs.ac.tz
[150] http://www.suanet.ac.tz/

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- Research focus include: eAgriculture, Food Security, eHealth, Data mining, Technology-enhanced learning

16.4.3 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	Partners include
eHealth	Ifakara Health Institute; Muhimbili University of Health Sciences
eAgriculture	Sokoine University of Agriculture

16.4.4 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
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

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**

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	Kilimanjaro Christian Medical University College
Food Security, Sustainable Agriculture	**Sokoine University of Agriculture:** Sustainable Agriculture, Food Security **Open University:** Agriculture and Food Security
Energy	**Ardhi University**
Transport	**Ardhi University** **National Institute of Transport**
Climate Action, Environment, Resource Efficiency and Raw Materials	**Open University:** 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 more than 39 projects and securing research funding of over **€12 million** under FP7. There is a strong policy focus (driven by COSTECH, MCST 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.

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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 34 governorates (administrative divisions). The population as at July 2014 was estimated at 10.9 million inhabitants with a literacy rate of 79% (CIA World Factbook). 69 percent of the total population is between 15 and 64 years of age. Tunis, the capital city, has a population of 790,000 (2011, CIA World Factbook). 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, health, e-learning, 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.

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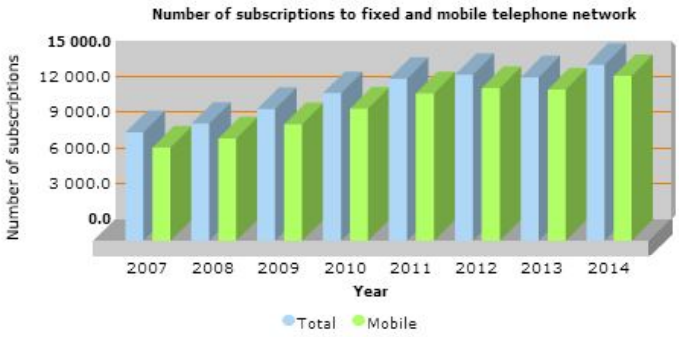
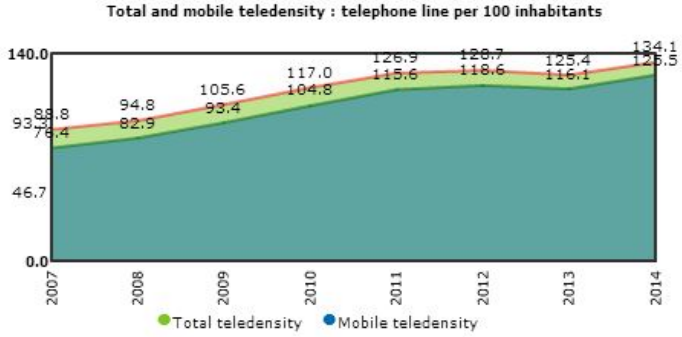
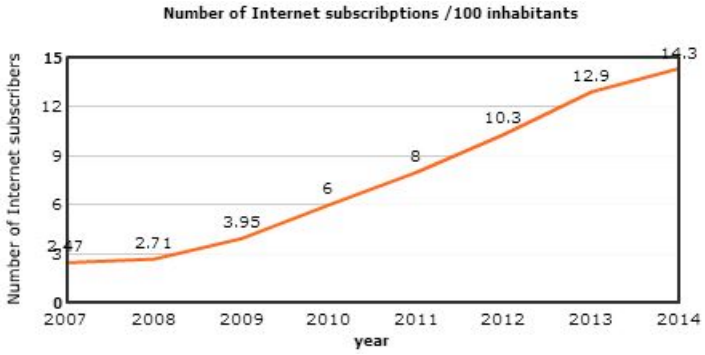
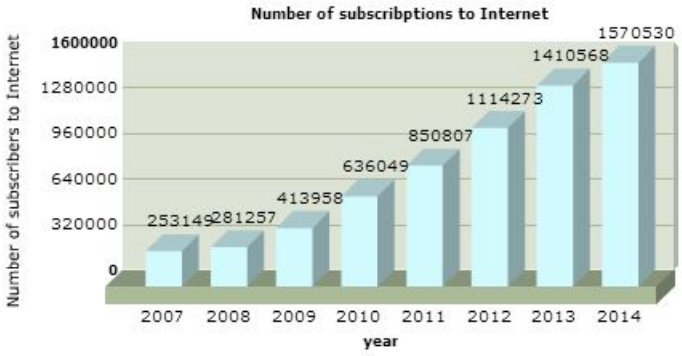
In terms of Communications, there are three main phone companies (Tunisiana, Tunisie Telecom and Orange) and one main Internet wholesaler (Agence Tunisienne de l'Internet). Since January 2013, the three phone companies had direct access to the international Internet backbone. Based on statistics published by the Ministry of Higher Education and Scientific Research and Information and Communication Technologies[151], the levels of mobile subscriptions continue to increase gradually from 13 million in 2013 to almost 14 million in 2014.





During 2014, the number of Internet subscribers increased to 1.57 million





There are 14 public universities (195 public institutions) and 44 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, Scientific Research and Information and Communication Technologies 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 (17.5% in 2007-2011) and good contribution to GDP. During the period 2007-2011 there was a growth in investment and profits derived from investments of about 6.3 billion

[151] http://www.mincom.tn

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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% in 1992 – 1996 to 40% in 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
- Data base management or distant services application

The updated ICT policy was reviewed and published with input from the Ministry of Higher Education and Scientific Research and Ministry of ICT. The eGovernment and eAdministration Strategy has been in place since 2005 under the eGovernment Unit. Tele-centres exist in every town and almost every village.

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 92.5 Gb/s in 2013. 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 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++.

ATI[152] (Agence Tunisienne de l'Internet - Tunisian Internet Agency), which operates under the Tunisian Ministry of Industry and Technology, was founded in March 1996 to promote Internet

[152] http://www.ati.tn

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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

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.

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:

- Data processing and multimedia in Sfax;
- Data processing and 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.

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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, development of technological partnerships and for the support of company creation.

17.3.1.3 Cyber Parks

A network of cyber parks dedicated to provide on-line services across the entire country. During 2009, this network reached 14 cyber parks.

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.

- RITI[153]: 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)
- A 10-year national plan for technological parks
- Network of 30 business incubators (2010): an incubator for every technological higher education/educational institution. The 30 business incubators in Tunisia networked through the “Business Incubators Network in Tunisia”. 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

[153] http://www.eriti.mincom.tn

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17.3.2.2 Support for Software Firms

Support for Software Firms includes:

- Legislation specific to stock options in favour of ICT companies
- 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

17.4 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 7% of the state budget to education. This effort can be seen in the education statistics outlined below:

- 13 public universities and a virtual university
- 195 public higher education institutions and 44 private institutions of higher education
- The number of students increased 8 times with 370,000 students at the end of 2008, (including 59% who were female) to 399,619 students (among them 209,064 females).
- Almost 13,000 students in high standing European, Canadian and American universities
- Computerization and internet connectivity of all higher education institutions
- More than 50,000 students enrolled in ICT training – representing approximately 14% of the student population
- More than 9500 ICT graduates per year
- More than 200 ICT training specializations within more than 50 public and private higher education institutions

Tunisia regards the mastery of knowledge and technology as a crucial factor in economic and social development. Consequently, the country is constantly consolidating investment in knowledge and securing the adjustment of 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

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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.

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, University of Sfax; INSAT and SupCom University of Carthage
- Improve 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, University of Sfax; SupCom, and INSAT: University of Carthage; ENSIT, University of Tunis
- 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, University of Sfax; INSAT and SupCom University of Carthage

17.4.2 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 Tunis	Tunis	27499 (2010-2011)	Higher School of Sciences and Techniques of Tunis	77	2230	119
University of Tunis El Manar	Tunis El Manar	42628 (April 2012)	Faculty of Mathematical, Physical and Natural Sciences of Tunis National School of Engineers of Tunis Higher Institute of Computer Science of El Manar	179	4763	203
University of Carthage	Carthage		Faculty of Sciences of Bizerte Tunisia Polytechnic School Higher School of Technology and Computer Science of	256	4842	90

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			Carthage National Institute of Applied Sciences and Technology Higher Institute of Applied Sciences and Technology of Mateur			
University of Manouba	Manouba	26138	Higher Institute of Multimedia Arts of Manouba National School of Computer Sciences	92	5602	74
University of Jendouba	Jendouba		Higher Institute of Computer Science of El Kef Faculty of Juridical, Economic Sciences and Management of Jendouba	45	2575	69
University of Sousse	Sousse	32765	Higher Institute of Computer Sciences and Communication Techniques of Hammam Sousse National Engineering School of Sousse	151	4004	99
University of Monastir	Monastir	28132 (2011-2012)	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[154]	107	3529	11
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	64	1976	132
University of Sfax	Sfax	38882	National Engineering School of Sfax Faculty of Sciences of Sfax Higher Institute of Electronic and Communication of	261	5445	352

[154] www.isima.rnu.tn

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			Sfax Higher Institute of Computer Science and Multimedia of Sfax			
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	57	1730	44
University of Gabes	Gabes	22472	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 Gabes Higher Institute of Industrial Systems of Gabes Higher Institute of Computer Sciences of Medenine	154	4455	48
Higher Institute of Technological Studies	Tunis	27453	Department of Computer Sciences	743	8214	0

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

- **University of Tunis**[155]- 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**[156]
  - 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

[155] www.utunis.rnu.tn
[156] www.utm.rnu.tn

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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**[157]
  - Faculty of Sciences of Bizerte[158]: Computer sciences
  - Tunisia Polytechnic School[159]: Optical, Microwave and wireless networks and systems;
  - Higher School of Technology and Computer Science of Carthage (ESTI) [160]: Computer Systems and Software, Network Management and Services;
  - National Institute of Applied Sciences and Technology (INSAT) [161]: Optimization of Wireless Networks of the future; Internet of things; Operation and management of large volumes of 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 Tunis[162]: 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**[163]
  - National School of Computer Sciences (ENSI) [164]: Internet of Things (IoT) Communications Machine-to-Machine (M2M) & Internet ubiquitously, Green Communications, Smart Grid

[157] www.ucar.rnu.tn
[158] www.fsb.rnu.tn
[159] www.ept.rnu.tn
[160] www.esti.rnu.tn
[161] www.insat.rnu.tn
[162] http://www.supcom.mincom.tn
[163] www.uma.rnu.tn
[164] www.ensi.rnu.tn

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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**[165]
  - Faculty of Juridical, Economic Sciences and Management of Jendouba[166:] Computer sciences
- **University of Sousse**[167]
  - Higher Institute of Computer Sciences and Communication Techniques of Hammam Sousse: Engineering of knowledge and information
  - National Engineering School of Sousse [168]: Industrial computer sciences
  - Higher School of Sciences and Technologies of Hammam-Sousse[169]
- **University of Monastir**[170]
  - 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**[171]
  - Higher Institute of Computer Science and Management of Kairouan[172]
  - Higher Institute of Applied Sciences and Technology of Kairouan[173]
  - Higher Institute of Applied Mathematics and Computer Science of Kairouan
- **University of Sfax** [174]
  - National Engineering School of Sfax (ENIS) [175:]: Computer sciences, Signal processing; High Performance computing, Future Internet, Robotics, Mobile networks and computing, Smart

165 www.uj.rnu.tn
166 www.fsjegj.rnu.tn
167 www.uc.rnu.tn
168 www.eniso.rnu.tn
169 www.essths.rnu.tn
170 www.um.rnu.tn
171 www.univ-k.rnu.tn
172 www.isigk.rnu.tn
173 www.issatkr.rnu.tn
174 www.uss.rnu.tn
175 www.enis.rnu.tn

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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 Sfax[176]: Computer sciences
- Higher Institute of Electronic and Communication of Sfax[177]: Networking
- Higher Institute of Computer Science and Multimedia of Sfax[178]: Multimedia and computer sciences

- **University of Gafsa**[179]
  - Faculty of Sciences of Gafsa[180]
  - Higher Institute of Applied Sciences and Technology of Gafsa
  - Higher Institute of Sciences and Energy Technology of Gafsa
- **University of Gabes**[181]
  - Faculty of Sciences of Gabes[182]
  - National Engineering School of Gabes[183]
  - 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 University[184]: 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	Institut Pasteur de Tunis; Neurone Institute; Salah Azaiez Institute of Cancer Studies; ISI, University Tunis El Manar; ENIT, University Tunis El Manar; ENSIT; ENIS; SupCom

[176] www.fss.rnu.tn
[177] www.isecs.rnu.tn
[178] www.isimsf.rnu.tn
[179] www.ugaf.rnu.tn
[180] www.fsgf.rnu.tn
[181] www.univgb.rnu.tn
[182] www.fsg.rnu.tn
[183] www.enig.rnu.tn
[184] www.uvt.rnu.tn

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eAgriculture & Environment	Water management; eAgriculture	INAT Carthage University; ENSI, Manouba University; IRESA; INSAT; ENIT
Technology-enhanced Learning	Distance Learning; Access to computational grids	Université Virtuelle de Tunis; CCK; ENSI, University of Manouba; INSAT, University of Carthage; SupCOM, University of Carthage; ATI
eGovernment	Service Delivery	CNI; ENSI, University of Manouba; ISAT, University of Carthage

17.4.4 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	**SupCom (Dept. of Computer Science and Networks and Doctoral school of ICT):** Smart embedded components and systems **ENSI (Dept. of Embedded Systems and Networks and Security Systems):** Smart embedded components and systems, technologies for IoT **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
Advanced Computing	**ENSI (Dept. of Information Systems and Decision):** Processor and system architecture, cloud computing **INSAT (Dept. of Computer Sciences and Mathematics):** cloud computing, parallel computing and simulation software **SupCom (Dept. of Computer Science and Networks and Doctoral school of ICT):** Processor and system architecture **ENIS (Dept. of Computer Sciences and Applied Mathematics):** Processor and System Architecture, Interconnect and Data Localisation Tech, Parallel Computing and Simulation Software.
Future Internet	**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 **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

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	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, Immersive Interactive Multimedia **INSAT (Dept. of Computer Sciences and Mathematics):** Networks, Software and Services, Cloud Computing, Cyber Security, Wireless Communications and All Optical Networks **ENIT (Dept. of ICT):** Networks, Software and Services, Cloud Computing, Cyber Security, Wireless Communications and Optical Networks **University of Tunis (Higher School of Sciences and Techniques):** Wireless communications, image and video processing, signal processing **ENIS (University of Sfax):** Signal processing, Cloud computing, Wireless Communications
Content Technologies & Information Management	**ENSI (Dept. of Information Systems and Decision):** Technology-enhanced Learning, Content Access and Analytics; Big Data Technologies' Advanced Data Mining, Machine Learning **ENIS (Dept. of Computer Sciences and Applied Mathematics):** Technology-enhanced Learning, Content Access and Analytics; Big Data Technologies' Advanced Data Mining, Machine Learning **University of Tunis (Higher School of Sciences and Techniques):** Technology-enhanced Learning
Robotics	**ENSI (Dept. of Embedded Systems and Networks and Security Systems):** Service Robotics, Advanced Interfaces **ENIS (Dept. of Computer Sciences and Applied Mathematics):** Service Robotics, Advanced Interfaces

Horizon 2020 Societal Challenges	**Institution, Relevant Dept and Research area**
Health	**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; **SupCom (Dept. of Applied Mathematics, Signals and Communications):** eHealth; health data collection **ENSIT (Dept. of Electrical engineering and computer Sciences):** eHealth; Self-management of health **Institut Pasteur de Tunis** **Institut National de La Sante Publique**

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Food Security, Sustainable Agriculture	**SupCom (Dept. of Applied Research):** eSustainable Agriculture and Forestry; **INSAT (Dept. of Computer Sciences and Mathematics):** Management of water resources in arid regions **ENIT (Dept of ICT):** Management of water resources in arid regions. **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**
Energy	**ENIS (Dept. of Electrical engineering):** Smart cities; Smart electricity Grids; Smart Metering; Low-Cost, New Knowledge and Technologies **SupCom (Dept. of Electronics, Physics and Propagation):** Smart cities; Energy Efficient buildings; Smart electricity Grids; **ENSI (Dept. of Embedded Systems, Networks and Security Systems):** Smart cities; Smart electricity Grids; Smart Metering; Low-Cost, New Knowledge and Technologies **ENSIT (Dept. of Electrical engineering and computer Sciences):** Smart cities; Smart electricity Grids; Smart Metering; Low-Cost, New Knowledge and Technologies **Alternative Energy Systems SARL** **Ecole Nationale d'Ingenieurs de Tunis.**
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,

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	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. 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. 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. Tunisia is positioning itself as a main regional hub for the Mediterranean region in ICT research and development activities.

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18. REPUBLIC OF UGANDA

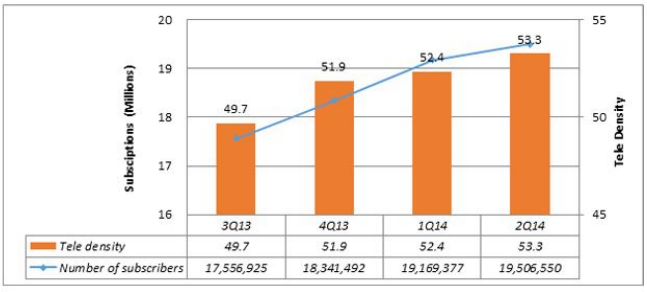
18.1 Introduction

The Republic of Uganda is located in East Africa, bordered by Democratic Republic of the Congo, Kenya, Rwanda, Sudan and Tanzania. Uganda has an area of 241,038 km² and 112 administrative districts. The population as at July 2014 was estimated at 35.9 million inhabitants with a literacy rate of 73.2% (CIA World Factbook). Forty nine percent of the population is between 15 and 64 years of age. Kampala, the capital city, has a population of 1.659 million (2011, CIA World Factbook). English is the official language.

Uganda is a fertile country with regular rainfall and mineral deposits of copper, cobalt and gold. Oil has recently been discovered. Agriculture is the most important sector of the economy, employing over 80% of the work force, followed by services and industry.

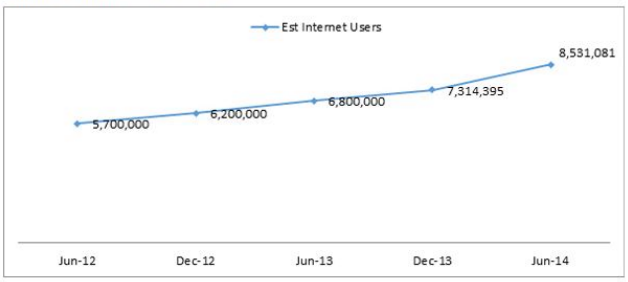
In relation to Communications, according to Uganda Communications Commission there were 19.5 million subscribers (fixed and mobile) and a teledensity of 53.3% as at June 2014. There were 4.19 million mobile internet subscribers, 106,900 fixed internet subscribers and an estimate of 8.5 million internet users as at June 2014.

Telecom subscribers & Penetration Data, June 2014



	3Q13	4Q13	1Q14	2Q14
Tele density	49.7	51.9	52.4	53.3
Number of subscribers	17,556,925	18,341,492	19,169,377	19,506,550

Estimated Internet Users, June 14



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.

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 have been completed. This 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

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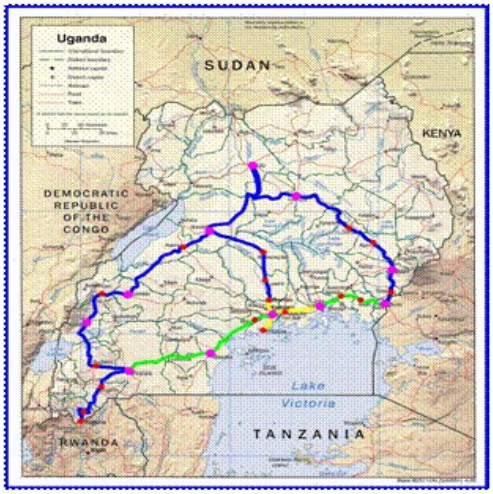
departments through the laying of optical fibre cable onto the e-government network. Twenty-two district headquarters across the country have so far been connected and are benefiting directly from the project.

The completion of the 2nd phase also enabled the connection of NBI to the borders of Southern Sudan (Elegu) and Kenya (Malaba and Busia) thereby linking the country to other regional backbone infrastructure and the 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. Twenty-seven Ministries, some Departments and twenty-two district headquarters across the country have been connected. There is a plan to optimise utilization of the existing NBI, implement Phase III of the NBI, implement the alternative route to the submarine cables (Masaka-Mutukula via Tanzania), implement the Masaka – Katuna OFC network and implement last mile connectivity to Local Government Services, Universities, research institutions and hospitals. 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.



Phase	Total distance	Sites
Phase I	188.26km	5
Phase II	1542.33km	19
Phase III	407.8km	4
Total	2118.64km	28

The Rural Communications Development Fund (RCDF), which has been established over 5 year 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 Internet Points of presence, Internet cafes, multi-purposes community tele-centres, ICT laboratories in schools etc.

There are six public Universities, 29 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

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framework. The sector is growing steadily and has contributed 2.5% to Gross Domestic Product (GDP) in 2011 and 6.2% to GDP in 2012. The Information and Communications Technology (ICT) sector is now regarded as a vital pillar for the social economic development of the country as indicated in the current National Development Plan (2010/11 - 2014/15). It is committed 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.

There are five telecom providers: MTN, Airtel, Uganda Telecom Ltd, Orange and Smile. Infrastructure capacity is rapidly improving. The National Data Transmission Backbone Infrastructure (NBI) and the Optical Fibre Cable across the country is well developed, connecting major economic centres.

Although still small, export of ICT services has started generating foreign exchange inflows. With virtually no earnings in 2001, the sector now earns over US $10 million per annum. ICTs in Uganda have been identified as a major tool for achieving socio-economic development. In order for the government to implement the long term National Development Programmes (NDP) timely, relevant information must be available at all levels of implementation. The integration of ICT into the NDP will increase growth, income and employment through skilled and semi skilled job creation.

The Government of Uganda has recognised the critical importance of ICT in national development, and has initiated a policy framework to implement these technologies throughout the country. A number of policy and regulatory reforms have 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 (August 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) is currently under review.

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 is currently under review

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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.

The following projects have been implemented by the Rural Communications Development Fund (RCDF)[185]:

Projects Completed	Number
Internet POPs	76
Internet Cafes	106
ICT Training Centres	78
MCTs	13
Public Pay Phones	4,099
Web Portals	78
Postal Tele-Centres	45
School ICT Labs	708
Health ICT Facilities	175
GSM Sites	90
Content Development	10
Local Governance	2
Institutions of Higher learning ICT labs	548
Unique Projects i.e. Adv Tele-Med, Post Code, Broadband	31

A lot of milestones in terms of policies were achieved during FY 2011/2012 including approval of IT Policy by Cabinet; IPv6 Transition Strategy; National Information Security Strategy; IMS Policy submitted to Cabinet for approval; Framework for the Institutionalization of ICT Functions in MDAs finalized and submitted to MoPS for further management; and concept paper on the establishment of IT Parks developed and approved by the NITA-U Board. The main achievements during FY 2012/2013 is not yet published.

18.3 Current ICT Initiatives and projects

Uganda is currently implementing a 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 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

[185] http://www.ucc.co.ug/data/smenu/71/Rural-Communications-Development-Fund---RCDF.html

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ICT Resource Centre, Village Phone Project), ICT for Rural Development and Entrepreneurship (Microsoft Innovation Centre).

18.3.1 Research and Education Network Uganda (RENU)

RENU[186] 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.

RENU is a member of UbutuNet 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 and has 10 – 12 active members (public and private universities), who all pay the same 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. In the future it would like 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.

Currently it does not have its own network. Under AfricaConnect, a transcontinental network will be established. The Government will provide the national network and Members will address the last mile. There are plans to have 70% of the physical network up to the campus gate by 2014. If the NREN network can build on the national backbone, services can also be provided to schools and hospitals. At campus level, network management training is needed.

18.3.2 World Bank Cycle II project Development Process

The World Bank Board approved a total grant amount of US$8 million for ERT cycle II programme under an ICT sub-component. The main investment programme of the project includes sub county broadband services for Northern Uganda and Communication Information Centres are planned to be implemented. The National Commission for Science and Technology has put the criteria for disbursement of the funds in place.

18.3.3 eGovernment

There are a number of activities related to eGovernment currently running including:

- The e-Government readiness survey is being conducted. The survey will assist in establishing the current status of availability, access and usability of ICTs for governance and service delivery.

[186] http://renu.ac.ug/

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- Piloting of Unified Messaging Collaboration System (UM&CS) - for intra and Inter-institution communication and data sharing has been completed in two MDAs – NITA U and MOICT. The State House will be next in the pilot before UMCS is rolled out to other MDAs. The proposal for roll out is already prepared.
- Piloting of Voice over Internet protocol (VoIP) has been finalised in NITA U, MoICT and Ministry of Internal Affairs and a roadmap for roll out has also been developed. UMSC and VOIP aim at improving efficiency in flow of information across government and cutting own on communication costs.
- The plans are underway to establish a government portal (www.gov.ug) that will ensure that government information are uploaded and managed under a single resource/facility so as to improve security of information and improve its shareability.

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.

Phases I and II of The NBI have been completed and consists of the following:

- 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.

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.

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Achievements to date include:

1. Delivery and installation of communication equipment to the 27 Ministries and Departments that form the E-Government network was 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 Affair 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.
6. A detailed quality assurance process has been developed to ensure quality of Phase I and Phase II of the NBI/EGI Project.

The NBI Phase III will connect Kabale, Katuna, Malaba, Masaka and Mutukula. Phase III will also provide an alternative route to the undersea cables at Mutukula through mainland Tanzania to the East African Submarine cables and will also connect Uganda to the Rwandan border. All other districts will be reached using the last-mile connectivity programme using other connectivity technologies such as WiMax.

The Parliament of Uganda has approved the implementation of Phase IV to facilitate the connection of Sironko, Kapchorwa, Nakapiripirt, Moroto, Kotido, Kitgum, Adjumani, Moyo, Yumbe, Arua, Nebbi and Pakwach towns. Since funding for Phase IV is not covered under the concessional loan from the People's Republic of China, the Government of Uganda will source the necessary funding.

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 aims 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 envisages 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.

Migration from analogue to digital broadcasting has commenced in the Kampala Metropolitan area, following the handing over of signal distribution equipment to the Uganda Broadcasting Corporation

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(UBC). However the analogue signals continues being distributed alongside the new digital signals. New set top boxes are now available with DVB-T2 technology, a digital terrestrial transmission system developed by the DVB project.

Funding sources: Chinese government and implementation by the Uganda Ministry of ICT

Geographic scope and time frame: National; ongoing.

18.3.3.3 Voter registration- Electro Commission Uganda project

This project focused on enhance transparency, accountability in the election management process, increase voter confidence in the electoral process in the 2010 general elections. 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.

Issuance of identity cards and the mass registration process is ongoing[187]. It is expected that by December 2015, all eligible Ugandan citizens of voting age (18 years and above) will have been registered and issued with a national identification card and a unique National Identification Number (NIN).

Organization(s)/funding sources: Uganda Government, Implementation overseen by Uganda Ministry of ICT

Geographic scope and time frame: National

18.3.3.5 ICT4Democracy in East Africa

The ICT4Democracy in East Africa project (June 2011 - July 2013) was based on leveraging the potential of ICT to increase citizens' participation in decision-making processes, thus strengthening

[187] http://www.immigration.go.ug

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democratisation. Launched in June 2011, the ICT4Democracy Network in East Africa consists of 7 partners in Kenya, Uganda and Tanzania (Kenya Human Rights Commission, iHubResearch-Kenya, Commission for Human Rights and Good Governance-Tanzania, Toro Development Network-Uganda, Women of Uganda Network, Transparency International – Uganda and The Collaboration on International ICT Policy in East and Southern Africa (CIPESA)). The Network initially received seed funding from the Swedish Programme for ICT in Developing Regions (Spider). It is a network of organisations collaboratively leveraging on Information and Communication Technology (ICT) to enhance communication and the right to freedom of expression, as well as the right to seek, receive and impart information to enhance civic empowerment and improve governance.

During late 2013, the network were successful in receiving a Grant of SEK 8.4 million from SIDA under the Swedish Government's Special Initiative for Democratisation and Freedom of Expression.

Organization(s)/funding sources: SPIDER / SIDA

Geographic scope and time frame: Regional - Kenya, Uganda, Tanzania

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 Project[188] 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); UConnect[189] supporting connectivity and training in schools (commenced activities in 1995) and iNetwork[190] Project (commenced in 2002 with support from IICD). More recent projects are described below.

18.3.4.1 Improving Learning Outcomes through ICT

The "Improving Learning Outcomes through ICT" project commenced in December 2011 and it will run until 31 December 2014. It is focused on improving learning outcomes for girls in particular in primary schools in the Apac District of Uganda through access to ICT. It aims to train teachers and school administrators in learner centered teaching and learning methodologies, facilitate access to up to date teaching and learning materials, build capacity of teachers, facilitate networking between schools and provide life skills to pupils for improved self confidence. The target group is 100 primary school pupils and 40 primary school teachers.

[188] http://www.idrc.ca/EN/Resources/Publications/Pages/ArticleDetails.aspx?PublicationID=716
[189] www.uconnect.org/
[190] www.i-network.or.ug/

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Organization(s)/funding sources: Partners include: Connect4Change, Edukans, IICD (Netherlands) and Education Local Expertise Centre Uganda, FAWEU and I-Network (Uganda). Funded through Grant of €36,000 from Edukans, Netherlands.

Geographic scope and time frame: Apac District of Uganda, December 2011 - December 2014.

More information available at http://projects.iicd.org/en/project/355/

18.3.4.2 ITELE for ICT (Improving Literacy and Numeracy in Primary Education through ICT)

IICD launched the "ITELE for ICT" project in December 2011 and it will run until 31 December 2014. It is focused on improving literacy and numeracy in primary education in the Serere District in Eastern Uganda through the integration of ICT in teaching and learning processes. The projects aims to train 20 teachers in 8 targeted primary schools and then 10 teachers per school by 2014 to develop Information Communication based teaching content, lesson planning and scheming and support pupils to design, develop and disseminate IEC materials that address community needs and concerns.

Organization(s)/funding sources: Partners include: Connect4Change, Edukans, IICD (Netherlands) and Education Local Expertise Centre Uganda, HNU and I-Network (Uganda). Funded through Grant of €39,568 from Edukans, Netherlands.

Geographic scope and time frame: Serere District in Eastern Uganda, December 2011 - December 2014.

More information available at http://projects.iicd.org/en/project/354/

18.3.4.3 Helping teachers use ICT for teaching

IICD launched the "Helping teachers use ICT for teaching" project in December 2010 and it is still active. It is focused on training teachers and sensitising Head Teachers in Western Uganda and West Nile of the importance of using ICT for Education and for school management. It aims to train 400 teachers and senior staff on how to use computers to improve classroom instruction, teaching materials and school administration in 13 schools.

Organization(s)/funding sources: Partners include: Connect4Change, CharITy, IICD (Netherlands), Close the Gap (Belgium) and Computers for Schools Uganda (CFSU), I-Network (Uganda). Funding of €110,820 from CFSU (€18,203), IICD (€35,117), Close the Gap (€47,500) and CharITy (€10,000)

Geographic scope and time frame: Western Uganda and West Nile, December 2010 - ongoing

More information available at http://projects.iicd.org/en/project/213/

18.3.5 eHealth

18.3.5.1 Improving health care delivery through continuing medical education for rural health

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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.

18.3.5.2 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.

18.3.5.3 Health Child / STAR Parent

The STAR Parent project builds on past projects implemented by Health Child to improve maternal and child health conditions in Uganda. It commenced in October 2012 and aims to run until 30 September 2015. ICT has been adopted to complement the project activities, which focus on improving pregnancy outcomes, neonatal and child survival. The project is implemented in close partnership with Village Health Teams, Local leaders, health centre, District Health Office and Ministry of Health.

Organisation(s)/funding sources: Partners include: 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, runs from October 2012 to 30 September 2015

More information available at http://projects.iicd.org/en/project/940/

18.3.5.4 e-Network

Makerere University Faculty 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

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a pan-African network through fibre optics and wireless links. This will enable the sharing of resources such as BlackBoard digital learning software, backups, and elearning courses. The faculty 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, Eriteria, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, Sudan, Tanzania, and Uganda.

Geographic scope and time frame: Eastern and central African regions; project was announced in July 2006.

More information available at http://cit.ac.ug/site/downloads/issue4.pdf

18.3.5.5 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 will also chronologically document the care of the mother during pregnancy and the child after delivery, thus offering an important element contributing to high-quality care. As with the rest of Africa, it will be paper based and therefore will have the inherent problems associated with manual paper based medical documentation systems. To ameliorate these problems, the paper system should be supplemented by an electronic system. This will revolutionise 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 will also improve 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

18.3.5.6 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,

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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 dug management reports

Organisation(s)/funding sources: Uganda Government

Geographic scope and time frame: National

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 2011with 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

18.3.6.2 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.

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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.

18.3.6.3 Village Phone Project

The Village Phone Project[191] provides micro loans to eight local businesses to enable establishing a community phone service. Testing of additional technologies will be done.

Organization(s)/funding sources: Grameen Foundation in partnership with MTN Uganda

Geographic scope and time frame: Started in 2003 in selected communities; ongoing.

18.3.7 ICT for Rural Development

18.3.7.1 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).

Geographic scope and time frame: National

18.3.7.2 Adaptive Bandwidth Management in Cooperative Wireless Networks: Affordable and equitable access to the Internet

In 2006, the Community Wireless Resource Centre[192] (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 objectives are 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;

[191] http://www.grameenfoundation.org/where-we-work/sub-saharan-africa
[192] http://cwrc.it46.se/

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(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.

Organization(s)/funding sources: Uganda Government under the MSI World Bank project

18.3.7.3 NUFFIC ICT[193] 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 (RUN) and Eindhoven University of Technology (TUE) to support University staff and students in the Ugandan institutions and ICT Policy makers.

18.3.8 Other ICT Initiatives

18.3.8.1 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.

[193] http://sida.mak.ac.ug/?p=919

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18.3.8.2 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

Seven main national research priorities have been identified for ICT development in Uganda: ICT for Governance; ICT for Citizen Empowerment; ICT to support human rights protection, peace and conflict resolution; eHealth; eEducation and Rural Access to ICT (Telecentres).

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

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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 ICT[194] (Computer Science, Information Technology, Information Sciences), Business School[195], East African School of Library and Information Science[196]
  - Research areas include: Mobile Applications, ICT for Governance and Policy modelling, eInfrastructures, Information Systems, Networks, ICT for Sustainable Development, Software Engineering
- **Kyambogo University**[197]
  - Departments include: Department of Computer Science; Department of Mathematics; Department of Physics;
  - Research areas include: Technology-enhanced Learning, Inclusive Society
- **Mbarara University of Science & Technology**[198]
  - 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)** [199]
  - Departments include: Faculty of Science & Technology - Departments of Computing, Environmental Science and Health Science
- **Gulu University**[200]
  - Departments include: Computer Science, Library and Information Services, Biosystems Engineering
  - Research areas include: eGovernance, eInclusion, eHealth, Technology-enhanced Learning, Agriculture, Environment
- **Kampala International University**[201]

[194] http://cit.mak.ac.ug/
[195] http://www.mubs.ac.ug
[196] http://easlis.mak.ac.ug/
[197] http://www.kyu.ac.ug
[198] http://www.must.ac.ug
[199] http://www.ucu.ac.ug/ucunew/
[200] http://www.gu.ac.ug
[201] http://www.kiu.ac.ug

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- Departments include: Computer Science - Information Technology and Systems, Electrical and Computer Engineering, Mathematics, Biological and Environmental Sciences

- **Uganda Martyrs University**[202]
  - 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 the following thematic areas are considered to be important in the context of the ICT-39 Call:

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; Mbara University of Science and Technology;
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**

[202] http://www.umu.ac.ug/

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	Mbarara University
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:** Epidemiology
Food Security, Sustainable Agriculture	**Makerere University (College of Agriculture and Environmental Sciences):** Sustainable Agriculture, Food Security, Agri-business
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 in collaborative research having participated in more than 41 projects and securing over **€ 7.7 million** in research funding under FP7. 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.

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.

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