ICT4D, A Driver of Socio- Economic Development in Rwanda: Situation 2000-2015

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Abstract
The government of Rwanda (GoR) committed itself to developing and implementing Information and Communication Technology for Development (ICT4D) policies and action plans within the context of the Vision for Rwanda to transform Rwanda’s predominantly agricultural economy by the year 2020 into: (i) A high-income economy dominated by trading in ICT products and services; (ii) An economy characterized by a large commercial services sector with a reasonably large and vibrant ICT services sub-sector and industry; (iii) An economy characterized by a technology-based and knowledge-driven industrial sector; (iv) An economy with a globally competitive industrial and services sector which is, to a large extent, driven by cutting-edge research and development (R&d) activities; (v) An economy based on a rich pool of highly skilled human resources in critical skill areas relevant for developing and maintaining a competitive edge on the global market”.

Adopted in 2000, Vision 2020 aims to transform Rwanda into a middle-income country and transition her agrarian economy to an information-rich, knowledge-based one by 2020. GoR strongly believes that Information and Communication Technology (ICT) can enable Rwanda leap-frog the key stages of industrialization. As such, GoR has integrated ICTs, through the National Information and Communication Infrastructure (NICI) process of four five-year rolling plans, as a key driver for socio-economic development to fast track Rwanda’s economic transformation, and consistently strives to align the country’s development agenda to global trends in order to be competitive. Rwanda strives to leverage ICTs in all sectors of the economy and is registering tremendous progress.

The present research aims to highlight key socio-economic improvements achieved by Rwanda due to the implementation of ICT technologies. Using Qualitative and Quantitative Methods, the research found that ICT has lead Rwanda to international awards justifying remarkable improvements achieved in all sectors such as Agriculture, Health, Education, Governance, Private Sector, Commerce, Finance and Business and Social welfare. In fact, in 2010, Rwanda was the top global reformer in the World Bank Doing Business report and second global reformer out of 183 countries in 2011. Rwanda is also the 9th easiest place to start a business in the world and the 6th most competitive economy in Sub-Saharan Africa. This has largely been a result of several reforms including online business registration, aimed at making the business environment more conducive.

Key words: Development, ICT4D, Information, Socio- Economic Development.
Jel Code: (01, 02)

Introduction
Global ICT policies have become more mainstreams in the last decade underpinning growth, jobs, increasing productivity, enhancing the delivery of public and private services, and achieving broad socio-economic objectives in the areas of healthcare, education, climate change, energy, employment and social development. As such, the global ICT industry is fast changing as a result of emerging technologies, economic, social and business trends. As ICT applications and services are becoming ubiquitous, they are increasingly essential for ensuring sustainable economic development, and Rwanda is no exception.

Rwanda has managed to show the highest annual economic growth rate of 8.2 per cent in the last 3 years. This continuous growth has been enabled in part by the government’s aggressive investments in Information Communication Technology (ICT) and the rapid expansion of the mobile
telecommunication sector. Furthermore, being landlocked has made it imperative for Rwanda’s continued development and investment in ICT (World Bank, 2013). Having recognized the importance of the ICT investments in achieving the socio-economic growth, the GoR adopted the National Information and Communications Infrastructure Plan (NICI) in 2000. NICI comprises 4 Plans each having proper targets towards achieving Vision 2020 Goals of making Rwanda a Middle Income Country.

**ICT Trends**

**✓ Internet**

In just a few decades, Internet is transforming the way we live, work, socialize and the way countries develop and grow. Its impact on economic wealth includes the creation of jobs, improved standards of living, and contribution to real growth. The United Nations in its Millennium Development Goals (MDGs) lists Internet penetration as a key metric in efforts to reduce poverty and encourage rational development. According to a 2011 McKinsey report, more than 2 billion people now use Internet in every country, in every sector, in most companies, and almost $8 trillion exchange hands each year though e-commerce and these numbers are still growing. E-commerce websites such as Amazon, iTunes, and Google Checkout, Kaymu are transforming global business transactions. Voice communication over the Internet (VoIP), blogging, Internet radio, Internet television, social networking sites, cloud computing, and Internet-based user applications are all contributing immensely to the rise in popularity and acceptance of the Internet as the primary communication method for many (McKinsey & Company, 2011).

**✓ Mobile Applications**

There is increased demand linking mobile payment systems with online based e-commerce and trading platforms globally. Today, there are more than 3.4 million mobile subscribers in Rwanda who are now able to purchase electricity and airtime anywhere at any time as a result of mobile payment systems. Rwandan software developers and telecom providers can work together to capitalize on this trend.

**✓ Outsourcing**

Outsourcing of help-desk services, desktop management, data-center services, and on-the-spot support services are on the rise. It is creating new job opportunities in the IT industry, stimulating the need for progressive and innovative strategies to connect employees from continent to continent. Demand for Business Processing Outsourcing services in Rwanda is estimated at $50 million, which will increase to almost $200 million by 2020 with regional market potential predicted to be $1900 million in 2020.

**✓ Information Security**

Information security is increasingly becoming of critical importance given the need to secure critical information currently available online. Rwanda is investing, and must continue to do so, in IT and information security to ensure that Rwandan’s information is not compromised.

**✓ Cloud Computing**

There is a shift in the global service model in which service providers are leveraging cloud computing technologies to offer “everything-as-a-service”. This is a new and swiftly growing approach to service provision. Today, Rwanda has constructed a national data center that is fully capable of maximizing the potential in cloud computing, paving the way for increased services development (Cloud Standards Customer Council, 2014).

**✓ Convergence**

Technological innovation and market demand are driving the ICT sector toward convergence. This trend is lowering barriers-to-entry; allowing service providers to try new business models; promoting competition; reducing costs for service providers and users, and broadening the range of services and technologies available to users. The growing use of Internet protocol (IP)-based packet-switched data transmissions has made it possible for various devices and applications to use any one of several networks, and interconnect previously separated networks. Service providers around the world are embracing convergence through investment in all-IP networks – estimated to reach a cumulative total of $200 billion in 2015 – and in converged business models. 8 Rwandan telecom companies are also following this trend by converging voice and data network infrastructure.
In order to compete in an increasingly globalized market place, developing economies need to not only use ICT, but also ensure the availability of ICT to all sectors of the economy. This requires a significant investment in infrastructure, capacity building, and a policy environment that fosters innovation and growth. Rwanda, through the NICI process, has created an enabling environment and deployed critical infrastructure for ICT growth and development. NICI III aims to capitalize on this to accelerate services development through ICT by running efficient government services and improving business efficiency and productivity, thereby facilitating sustainable economic competitiveness for Rwanda (GoR, 2011a).

1. ICT and Economic situation before 2000

Rwanda Information Technology Authority (RITA), 2006 summarizes the situation of ICT and Economic situation in Rwanda before 2000 as follow:

✓ Economic Situation

<table>
<thead>
<tr>
<th>Economic Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rwanda's economy</td>
<td>predominately subsistence agriculture</td>
</tr>
<tr>
<td>Agriculture working population</td>
<td>91.10%</td>
</tr>
<tr>
<td>Industrial sector population</td>
<td>7.20%</td>
</tr>
<tr>
<td>GDP (1998)</td>
<td>US$1.9 billion</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>US$198</td>
</tr>
<tr>
<td>Contribution to GDP (1998)</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>45%</td>
</tr>
<tr>
<td>Industry</td>
<td>19%</td>
</tr>
<tr>
<td>Commerce and services</td>
<td>26%</td>
</tr>
<tr>
<td>Others</td>
<td>10%</td>
</tr>
<tr>
<td>Export earnings (1998)</td>
<td>US$64.4 million (100%)</td>
</tr>
<tr>
<td>Coffee</td>
<td>US$25.9 million (49%)</td>
</tr>
<tr>
<td>Tea</td>
<td>US$22.9 million (44%)</td>
</tr>
<tr>
<td>Others</td>
<td>US$15.6 million (7%)</td>
</tr>
<tr>
<td>Export percentage of GDP (1998)</td>
<td>5.60%</td>
</tr>
</tbody>
</table>

NB: Agriculture production is far from being commercialized or industrialized, for example agro-business is not developed in Rwanda.

✓ ICT Sector Situation

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Key Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunication Infrastructure and Services</td>
<td>(i) Two telecommunications service providers: Rwandatel, (99.9% government-owned at the time), first cellular provider operating a GSM mobile network and the sole Internet Service Provider in Rwanda; &amp; Rwandacell (partly government-owned at the time). (ii) Rwanda had about 8,000 telephone lines before the 1994. By 1998, Rwanda had of about 20,000 lines with 26,000 equipment capacity. (iii) By 2000: Telecommunications infrastructure was being digitized; rural telecommunication connectivity programme was then underway; New technologies were being deployed: Network Digitization Systems, Pair gain Technology, Smart Card Payphones, Wireless Local Loop Systems; Other technologies were planned: ATM, Video Conferencing, ISDN, LEO, and Satellite Broadcasts. (iv) In 2001 The total number of fixed telephone lines was only 22,000 lines. There were only 78,000 mobile subscribers and only 128 rural telephone lines.</td>
</tr>
<tr>
<td>ICT Level, Penetration and Utilization</td>
<td>(i) Very few Government Ministries and Public Services Organizations (PSOs) have computerized their operations although some of them, at the time have computers in some of their offices. (ii) All the Banks were</td>
</tr>
</tbody>
</table>
computerized; (ii) most of the large private sector organizations were then using computers; (iii) NGOs and International Agencies were reasonably computerized. (iii) 1999, the total number of PCs in the 43 public service institutions surveyed was estimated at 1,264 (Kigali Institute for Science and Technology (KIST) then had the highest number of 137 PCs, followed by the Ministry of Defense with 130 PCs and then the Ministry of Local Government with 122 machines). (iv) The computer systems in most of the organizations in the civil and public services were not networked. (v) In most cases computers were being used for basic computing work like word-processing. Information systems (MIS, DSS), databases, personnel management systems, accounting and budgeting were not developed.

**ICT Sector and Industry**
The Rwanda ICT sector and industry was under-developed. No company at the time was involved in the assembly of computers and other equipments and software development activities were nonexistent. Companies were mainly involved in the sale of computers assembled outside the country.

**The Level of Internet Connectivity and Spread**
(i) Rwandatel was the only ISP in Rwanda, operating a 256kpbs gateway link to the Internet and has a POP in Kigali where is the majority of its subscribers. The use of Internet then was not widespread outside Kigali. (ii) In the cases of the connected government Ministries, access was mainly by dial-up and in most of these cases only one or two offices were connected to the Internet within the entire organization. The main use of the Internet then was mainly for e-mail and occasional Web browsing. (iii) Business organizations, the banks, NGO, diplomatic and the international agency communities were connected to the Internet mainly by dial-up access.

**Deployment of Cyber Cafes and Telecenters**
Rwanda had only one cyber café in operation. No Tele-center.

**The Local ICT production industry**
(i) ICT equipment used in Rwanda including telecommunication equipment, radio and TV equipment, communication equipment like fax machines as well as computer hardware were imported. (ii) Little software development work being done at the time was carried out using mainly expertise from outside the country with very little local input.

**ICT Human Resource Development**
(i) Rwanda was facing a serious shortage of skilled ICT manpower in all sectors. The lack of human resources in all the key skill areas has been identified as one of the development changes facing Rwanda. A number of the Government Ministries lack the requisite professional and technical personnel to support key operations and activities within these organizations. In the area of ICTs the majority of public organizations as well as those in the private sector, did not have key IT personnel in areas like: networking, systems development and support, programmers, software developers, systems administrators and managers among others. (ii) There was a serious lack of computer system development, implementation and maintenance skills in Rwanda in 2000/2001. The key areas of hardware, software and computer network systems development, and installation were equally affected.

**Information and Mass Media Sector**
(i) Rwanda had only one national Television network, and one national radio service. These were both run by the government-owned Rwanda Office of Information (ORINFOR). (ii) There were no daily papers in Rwanda. There were a number of weekly papers in Kinyarwanda, French and English.

**ICTs-in-Education**
Only one of the 2300 primary schools of Rwanda (namely the Kigali Academy) had computers.

**Telemedicine Initiatives**
There was no telemedicine in Rwanda before 2000.
ICTs in Agriculture

There was a very little deployment and the utilization of ICTs in the agriculture sector.


2.1. ICT Evolution: 2000-2005

The first NICI Plan, NICI I (2000-2005), focused on establishing an enabling environment to promote the development and growth of Rwanda’s ICT sector. During this period, the government undertook a process of privatization and market liberalization, resulting in the establishment of two mobile network operators—Rwandatel and MTN-owned Rwandacell—and three Internet service providers. Management of the ICT sector was delegated to the Rwandan Utilities Regulatory Authority (RURA) and the Rwandan Information Technology Authority (RITA). In addition, the National Information Technology Commission (NITC) was set up to serve as an advisory group and think tank. Specific infrastructure investments—such as a 150 kilometer fiber optic network concentrated in Kigali—were also made. Finally, in efforts to boost ICT skills, a national training center was created at the Kigali Institute of Science & Technology, and ICT training was offered at the National University of Rwanda. Indeed, ICT indicators showed little progress: in 2005, fixed-line penetration was at 0.3 percent of the population and mobile penetration at 2.5 percent. Only 0.6 percent of the population used the Internet (GoR, 2006). The following table summarizes ICT4D achievements during the period 2000-2005:

<table>
<thead>
<tr>
<th>ICT4D Indicator</th>
<th>Key Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT Companies licenced</td>
<td>3 Companies licensed to provide communication backbone network services including those of data, voice (fixed and mobile) and video services: Terracom Communications Ltd for providing mobile, fixed phones, VoIP and data services; Aertel Communications Ltd for providing rural as well as urban telecommunications services; Rwandacell for the provision of mobile services among other services.</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>(i)Fixed Telephone Lines: 25,000 in 2004 from 22,000 in 2001 (13% of change); (ii) Mobile Subscribers: 161,000 in 2004 from 78,000 in 2000 (106% of change). (iii) Rural Tel Lines: 565 in 2004 from 128 in 2001 (341% of change)</td>
</tr>
<tr>
<td>Deployment of Cyber Cafes and Telecenters</td>
<td>In 2005, there were over 30 reasonably-sized cyber cafes and 10 telecenters spread all over the country. These centers are used by the public for access to Internet, telephone, fax and secretarial services as well as basic computer training services. Kigali has 5 of those telecenters. All hotels and almost all Guest Houses and Inns have in-house cyber cafes to cater for their guests and the public. All the universities and colleges have cyber café facilities, some of these are opened to the public.</td>
</tr>
<tr>
<td>Telemedicine Initiatives</td>
<td>Pilot telemedicine projects are on-going in key hospitals: King Faisal Hospital (Kigali), CHK (Kigali), Batare Hospital, Central Hospitals in Ruhengeri and Cyangugu</td>
</tr>
<tr>
<td>Creation of Awareness</td>
<td>Serious efforts have been put into raising public awareness on the importance of the need to deploy ICTs to facilitate Rwanda’s development process. Rwanda is now regarded world-wide as a nation serious about the development, deployment and the exploitation of ICTs with its ICT4D Policy and Plan serving as a model for a number of African and other developing countries. It is now acknowledged both within and outside the country that ICTs is high on Rwanda’s development agenda.</td>
</tr>
<tr>
<td>Human Resource Development</td>
<td>Extensive training in the area of ICTs has been conducted targeting all level of staff within a number of the Ministries and PSOs. Training programme was implemented to train network technicians, computer technicians, software and support staff as well as computer system managers and administrators. Nation’s universities and colleges (The NUR, KIST, KIE ) have introduced new academic and other training programmes in a number of skills and professional areas to produce the requisite number of graduates for the public and the private sector.</td>
</tr>
<tr>
<td>ICTs-in-Education</td>
<td>There were 1138 out of the 2300 primary schools in Rwanda having a Computer (PC) or a Laptop, with 100 of these schools having about two PCs. Close to 2000 PCs have been deployed in the secondary schools throughout the country. The Ministry of Education planned to further procure and deploy 4000 computers in 400 schools starting 2005.</td>
</tr>
<tr>
<td>Government Administration and Service Delivery</td>
<td>(i)Government Ministries and the PSOs have been computerized; 28 Government Ministries and PSOs installed their Corporate Network; 7 Government Ministries/PSOs implemented their WAN. (ii) Government-wide Network (Gov-Net) System was implemented. Government Ministries Connected to the Fiber Backbone Network were Office of the President, Primer's Minister office –PRIMATURE, The Senate, Chamber of Deputies – National Assembly, Ministries (MINAGRI, MINIJUST, MINISANTE, MINAFFET, MINICOFIN, MINADEFF, MININFRA, MININTER, MIFOTRA, MINALOC, MINEDUC, MIGESPOC, MINITERE). PSOs Connected to the Fiber Backbone were Rwanda Information Technology Authority (RITA), King Faycal Hospital, National Post Office, Rwanda National Tender Board (NTB), Rwanda Revenue Authority (RRA), The Supreme Court, RIAPA, National Security Service, Caisse social du Rwanda, RIAM-GITARAMA.</td>
</tr>
<tr>
<td>Internet Connectivity and Access</td>
<td>(i) A number of the Ministries have VSAT links with others having leased line connections; (ii) 11 Ministries and PSOs with dial-up access to the Internet; (iii) 12 Ministries and PSOs with lease-line access to the Internet; (iv) 1 Ministries and PSOs with VSAT access to the Internet; (v) 13 Ministries and PSOs with VSAT with Wireless Internet Access; (vi) 18 Number of Ministries and PSOs with .gov.rw domain name.</td>
</tr>
<tr>
<td>Implementation of Organization-Specific Applications and Information Systems</td>
<td>Information Systems implemented are: Smart-Gov Budget Master System for MINECOFIN; Custom Clearance System (ASCUDA) for RRA; GEOMAP – Land Information and Administration System for Kigali City; Land Records Information System for MINITERE; National Social Security DataBase System for Social Security Board; Messaging and Collaboration System for Office of President; Payroll System for the Civil and Public Service for MIFOTRA; Messaging and Collaboration System for MINAFET; VISA Horizon System for MINICOM, BNR, SIMTEL; Telemedicine Applications for MINISANTE; Database System for Chamber of Deputies; Online Reservation System for ORTPN; Administrative and Students Records Information System for National University of Rwanda; RAMA Database System for la Rwandaise d’Assurance Maladie; E-education Application for MINEDUC; E-learning Applications for Kigali Institute of Education.</td>
</tr>
<tr>
<td>ICT Sector and Industry</td>
<td>Rwanda can now boast of a number of computer assembly companies and a few involve in the development of software and systems for the domestic and the export market. A number of web-based systems development companies have also started operating in Rwanda with some</td>
</tr>
</tbody>
</table>
of these involved in the development of web and other Internet applications. Computer training is rapidly becoming a major growth area with a number of locally established companies and foreign companies active in the sector. The provision of telecommunication and other communication services in the area of telephone services (fixed and mobile), Internet services, bandwidth services remains the major activity in the Rwanda ICT sector and industry.

ICTs in Agriculture

(i) The sector has then witnessed a lot of awareness creation as to the role of ICTs to support agricultural processes and activities including enhancing productivity, yield, processing, packaging, marketing and the delivery processes. This awareness is beginning to bear fruits as operators in the sector, including, farmers, agriculture service providers and decision makers are either adopting ICTs or exploring ways that these technologies can be used to improve and enhance their operations and activities. (ii) Apart from the use of the technology to train and conduct research in the agriculture colleges and research institutions, the Ministry of Agriculture has computerized its activities and operations including implementing its corporate network system. Also a number of ICTs in agriculture demonstration and pilot projects has been implemented and a number of these are on-going.

2.2. ICT Evolution: 2005-2010

GoR 2005 affirms that with the ultimate goals of wealth creation, poverty reduction and employment generation, NICI 2005-2010 placed emphasis on programs in ten thematic areas: Education, Human Capacity Development, Infrastructure, Equipment and Content, Economic Development, Social Development, e-Government and e-Governance, Private Sector Development, Rural and Community Access, Legal- Regulatory and Institutional Provisions and Standards, National Security, Law and Order. It also sought to enable an upgrade Rwanda’s ICT infrastructure, including a national ID smartcard program, a national data center, and greater access to international bandwidth. In Kigali, the municipal government partnered with RURA, RDB and the Ministry of Infrastructure to begin piloting wireless broadband. In 2009, a third mobile operator, Millicom/ Tigo, joined the market, leading to lower tariffs and a hike in subscriber numbers. At the end of NICI-2010, many ICT indicators pointed in a positive direction: mobile telephony and Internet uptake had grown substantially. In 2011, Rwanda had eleven Internet Service Providers (ISPs), 700,000 Internet users, and nearly six million mobile phone subscriptions. ICT sector revenues amounted to about RF100 billion (Musoni, 2012). GoR 2011 describes a series of achievement in ICT4D during the period 2006-2010:

<table>
<thead>
<tr>
<th>ICT4D Indicator</th>
<th>Key Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT Infrastructure and Technologies</td>
<td>Key ICT Infrastructure deployed including: the National fiber optic backbone; wireless broadband (WIBRO); National Data Centre; Broadcasting infrastructure, communication, navigation and surveillance-air traffic management system; The national fiber optic backbone network that is connecting Rwanda to international sea cables that facilitate increased affordability and access to Internet across the country; A national data centre has been developed, which allows Rwanda to centralize her information storage, management and protection, as well as take advantage of cloud computing opportunities; Communication, Navigation Surveillance and Air traffic management system (CNS-ATM) has been deployed, which greatly transformed air travel; migration from analogue to digital; Liberalization of the telecommunication industry; Two telecom operators – MTN and TIGO; Seven Internet service providers (ISPs) – MTN, TIGO, Altech Stream, Rwandatel, ARTEL, ISPA and Value Data Rwanda; ICT subscriber base increased: Fixed line (19,000 in 2000 to 39,664 in 2010), Mobile (42,000 in 2000</td>
</tr>
</tbody>
</table>
to 3,548,761 in 2010), Internet (1,200 in 2000 to 493,900 in 2010); Enactment of a law governing electronic messages, electronic signatures, electronic transactions; data protection; cyber security and ICT usage in government administrative procedures, Law Nº 18/2010 of 12/05/2010; SMART National ID; Connection to the international sea cables through Mombasa and Dar-es-Salaam.

Private sector
- ICT initiatives fostering Rwanda’s private sector development include several business and career development support services; online trade information portals; business incubators; online tax calculators; credit reference bureau; a land administration and management information system; electronic case management system; and improvements in online banking and e-transaction regulatory system. - In 2010, Rwanda was the top global reformer in the World Bank’s “Ease of doing business” ranking, moving up from 143rd in 2009 to 67th, the biggest jump ever recorded by any country. Online business registration was key to Rwanda’s improved ranking in 2011, where it currently ranks 58th.

Agriculture
ICT initiatives benefiting the agriculture sector include the Agricultural Management Information System (AMIS); an online exchange platform, “e-Soko”, a mobile market information solution that allows farmers and consumers to access market information for agricultural products. A Land Use Management and Information System has been implemented to ensure proper usage, planning and management of land.

Education
GoR has implemented numerous ICT in education initiatives including One Laptop per child (56,607 laptops deployed in 113 schools); ICT training for teachers; Schoolnet that aims to improve connectivity and deploy ICT tools in 12-year basic education schools; RwEdNet that is interconnecting Rwanda’s institutions of higher learning and linking them to global education and research networks, and the Rwanda Education Commons a onestop portal for education information.

Health
OpenMRS – an open-source medical records system that facilitates nationwide tracking of patient data; TRACnet – a system that allows central collection and storage of clinical health information; Mobile eHealth – a system used by community health workers to collect data for OpenMRS and TRACnet systems; Telemedicine – that is connecting King Faisal Hospital to Hospitals in Kabgayi and Musanze facilitating the sharing of clinical information between urban and rural hospitals, and most importantly allowing citizens to receive specialized treatment services remotely without travelling to Kigali.

E-Government
Modern and secure National ID and driving license; e-Cabinet; e-Parliament, document tracking and workflow management system; financial management system (FMS) and human resource management system (HRMS) have been deployed. Hundreds of local government officials and citizens have been trained in ICTs to promote ICT literacy and citizen participation in the country’s development.

2.3. ICT Evolution: 2010-2015
The third plan, NICI III (2011-2015 Plan), focuses more directly on ICT service delivery and targets local communities (ORINFOR, 2011). The five themes that the plan focuses on are (1) skills development; (2) community development; (3) private sector development of the ICT sector; (4) cyber security and (5) e- governance (GoR, 2010). Strong emphasis is given to capacity development of both local and rural communities and individual users, for instance through open and distance learning (Kanyesigye, 2011). This is expected to enhance private-sector development, as surveys among firm representatives show that lack of qualified staff for ICT jobs has held back growth. In addition, the private sector will be supported through the rollout of electronic payment
systems, as well as improved access to finance and entrepreneurial and business training for ICT providers (Musoni 2012). GoR 2014, summarizes ICT4D profile 2014 as follow:

<table>
<thead>
<tr>
<th>ICT4D Indicator</th>
<th>Key Achievements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Mobile Phone- Cellular Subscription</td>
<td>The country’s leading mobile telephony providers are MTN Rwanda, TIGO and Airtel. The network coverage accounts for 99.79%. In December 2014, mobile subscribers increased to 7,747,019 (70% of the population) from 6 689 158 subscribers (63.5%) in 2013 from 998 407 subscribers (53.1%) in 2012. MTN Rwanda Ltd has the largest number share of subscribers, followed by Tigo Rwanda Ltd and Airtel Rwanda Ltd with respectively 3, 556, 497 subscribers (53.17%); 2, 175, 127 subscribers (32.52%) and 957, 534 subscribers (14.31%).</td>
</tr>
<tr>
<td>Internet Subscription</td>
<td>Internet subscriptions reached 3,111,992 Subscribers from 2,068,179 in 2013 from 1,674,053 in 2012. This means that internet penetration rate was approximately 28% by December 2014 from 20% by December 2013. As result, by December 2014, 35.6 % of the Rwandan population is using Internet through their different devices.</td>
</tr>
<tr>
<td>SIM Cards registration</td>
<td>More than 6 million of SIM Cards were registered against valid identification documents in the period of 6 months.</td>
</tr>
<tr>
<td>National ICT Awareness</td>
<td>(i)Launched in Rulindo District in January 2013, the National ICT Awareness Campaign has expanded all Districts giving to citizens’ opportunity to be educated on how ICT can improve their productivity and socio-economic welfare. This initiative reached more than 165, 000 citizens. (ii)SMART Rwanda Days is an annual event high brings together various national stakeholders in the ICT sector–industry, experts, policy makers, development partners to discuss how Rwanda can leverage Information and Communication Technologies for economic transformation in line with the country’s Vision and plans. 2014 theme was “Digitizing Rwanda” where discussions were about Digital Payments, Internet Economy, Content Localization, Open data, SMART Africa Initiative, Meeting of the Minds, Digital Innovation among others.</td>
</tr>
<tr>
<td>Regional and International Integration</td>
<td>(i)Northern Corridor member countries adopt “One-Network-Area”, roaming charges to be scrapped and cost of calls reduce by 60%. Rwanda, Kenya, Uganda and South Sudan have mutually agreed to adopt a regional telecommunications framework for a One-Network-Area” by 31 December 2014. (ii) Rwanda has been re-elected a member state of the Council of the International Telecommunication Union (ITU) for 2014-2018. Rwanda earned 110 votes at the ITU Plenipotentiary Conference in Busan, South Korea. (iii) Rwanda continues to be one of the fastest growing African countries in ICT, from e-commerce and e-services, mobile technologies, applications development and automation to becoming a regional centre for the training of top quality ICT professionals and research. (iv) The Alliance for Affordable Internet (A4AI) has ranked Rwanda as the African country with the most affordable internet. The Alliance announced the rankings at the Mobile World Congress in Barcelona, Spain. The top five developing countries taking the most effective steps towards affordable Internet are all-African, and is topped by Rwanda, Nigeria and Morocco.</td>
</tr>
</tbody>
</table>
| Business and Finance            | (i) By December 2014, Rwanda had a total of 6,480,449 mobile payments subscribers, from 2, 538, 651 registered in 2013 against 1, 440, 541 registered in 2012 against 639, 673 in 2011. The volume of transactions through mobile telecommunication networks have been more than doubled reaching 691, 500 million Frw in 2014 from 330, 378 million in 2013 against 161, 808 million in 2012 from 51, 024 million in 2011. Subscribers use this service to purchase prepaid services such as phone credits, electricity, and other types of transactions. Growth rates of the payment through modernized systems, has been
Improved in the use of Rwanda Integrated Payments Processing System (RIPPS) in the first quarter of 2014 as customer transactions increased by 30.7% with the value of 2,024 billion in 2014, from 1,549 billion in 2013. (ii) Use of Point Of Sales (POS): The value increased exponentially to 18 billion Frw in 2013 from 8.4 billion Frw in 2012. In 2014, the number of POS increased by 22% whiles the volume of POS transactions increased by 88.4%. (iii) Up to 2014 from 2013, The number of ATMs increased by 6% whiles the number of debit cards tripled and credit cards increased by 131%. The Volume of ATM Transaction reduced by 6.8% due to different partnership between Telecoms and Banks to enable both their clients to cash out from their accounts through their mobile phones and vice versa while they also facilitated bill payments. The volume of ATM transaction was 7,278,355 in 2014 from 7,774,055 in 2013 against 5,753,163 in 2012 from 1,976,376 in 2011. (iv) Rwanda Revenue Authority began introducing the e-filing taxpayment system in November 2011. In 2014, number of Subscribers for e-Filing was 42,139 from 31,721 in 2013 against 2,659 in 2012.

Education

(i) Rwanda Education System is moving toward a student’s centric education supported by the integration of technology. The use of technology enables better teaching and better learning with students using digital, multimedia rich, interactive lessons enabling self-pace and collaborative learning. (ii) Rwanda remains the country in Africa with largest deployment of XO Laptops per child. 203, 763 XO Laptops have been distributed to 407 schools by December 2013. Digital contents were also deployed allowing students access in digital format and improving quality of education. Rwanda has launched Solar Power Internet School (SPIS) to facilitate using IT technologies in education. (iii) In November 2014, The Government of Rwanda signed an agreement with Positivo BGH. This plant will produce and sell ICT equipment to local markets and this will help a dissemination of ICT devices to schools and the key factor of successful implementation of technology in education of Rwanda. (iv) In recent years, the government of Rwanda has enhanced online learning to deliver cost effective, easily accessible and ever-current education to all ages and social backgrounds, regardless of time and geography. Since the system started; 5,357 students graduated in different courses, an increase of 69% in 4 years.

Health

(i) The percentage of health facilities connected to the internet reached 93.8%. Medical assistance call centers supported better delivery of health services at the community level with 25, 000 calls for ambulance in 2013. Telemedicine and e-Diagnostic improved the way medical professionals share expertise. (ii) Increase in Number of clinical emergencies supported through RapidSMS is 25%, while Number of Patients at community level tracked using RapidSMS reached 173,131 by December 2014 up from 158,510 in 2013, which make an increase of 9%. With strong partnership with private sector the Number of registered private clinics and dispensaries reporting routinely using HMIS has increased from 221 in 2013 to 275 in 2014.

Agriculture

(i) The number of farmers using Fertilizer Voucher Management System has an increase of 11% from 1,671,599 in 2013 to 1,859,413 in 2014. (ii) e-Soko supported more than 11,000 farmers to make informed market price decisions. (iii) In November 2013, MINAGRI with partnership with Center for Agricultural and Rural Cooperation (CTA) organized ICT for Agricultural Conference with brought over 500 delegated in Kigali to discuss ways to promote the application of ICT IN Agricultural Sector (Balraj & Pavalam, 2012).

ICT Technologies

(i) Analogue switched off in 2014; In October 2013, Rwanda endorsed the First National Broadband Policy allowing sale only 4G LTE network service provisioning. (ii) In November 2014 Rwanda Launched a Fourth Generation
Long-Term Evolution (4G LTE) Internet services. The launch of 4G LTE is one of many activities that our Government is putting in place so as to achieve a middle class knowledge based economy targets by 2020 (GoR, 2013a).

Governance

(i) A total of 12 institutions are now connected to the National identification Authority Database using online secure authentication, namely Traffic Police, RRA, MTN, TIGO, AIRTEL, B.N.R /Credit Reference Bureau, Immigration. 

(ii) The GCC is a centralized business intelligence and analytics system providing historical, current and predictive information on projects across all government institutions. 

(iii) Telepresence/ Videoconference network was used in all Districts, Provinces and Ministries. 

(iv) Rwanda Online was created to establish Integrated Service Platform to offer Government to Business (G2B) and Government to Citizens (G2C) services in the country, accessible via internet and mobile devices. Such services are Population Registry, Birth certificate, Registration for test/exam, Provisional and, Practical Driving License, Criminal Record Clearance Certificate, Building permits, Transfer of land title, Land-Subdivision Issuance of Trading License (Patent).

Rwanda Awarded by its ICT4D

During the year 2014, ICT sector in Rwanda continued to grow to boost the Country’s Social Economic Development. Several awards have given to the Government of Rwanda: 

(i) ITU (International TeleCommunication Union) awarded to H.E The President of Republic of Rwanda for having made exceptional contribution to improving life of world’s citizens through ICTs. 

(ii) StarTimes Group recognized H.E The President of Republic of Rwanda with the first ever “Number One in ICT and Telecommunication Award” for having set in Vision 2020 promotion of ICT and Communication. 


(iv) Northern Corridor countries agreed to adopt “One- Network- Area” joining Rwanda, Kenya, Uganda and South Soudan. The framework scraps roaming charges and reducing the cost of calls by 60%. 

(v) Rwanda launched faster Internet broadband network 4G LTE. 

(vi) Ministry of Youth and ICT Launched the awareness campaign of 4G LTE for Rwandans. 

(vii) First phase of implementation of Rwanda Online Platform Officially took off: this exclusively aims to offer Government to Business (G2B) and Government to Citizens (G2C) services in the country accessible via Internet and mobile devices. 

(viii) 2014 has noted SMART Rwanda conference. 

(ix) Rwanda collaborates with FaceBook to boost Social Education: FaceBook introduced SocialEDU, a pilot initiative to promote students in Rwanda with free access to a collaborative online education experience.

2.4. ICT target: 2015-2020

The fourth plan, NICI IV (2016-2020 Plan), in line with achieving the overall goal of Vision 2020 targets to turn Rwanda into a middle-income country and “an information-rich knowledge-based society and economy by modernizing its key sectors using information and communication technologies”.


The world’s economy has now transformed from not just an industrial economy but to an Information age, thus bringing Information and Communication Technologies to the fore front of a developed economy. Rwanda targets by 2020 to become Middle Income Country. ICT is seen as the sure driver that can lead the Country to the achievement of that goal. There are a number of roles played by ICT in development of Social- Economic Development in Rwanda, among which there are:
Agriculture: ICT initiatives benefiting the agriculture sector include the Agricultural Management Information System (AMIS); an online exchange platform, "e-Soko", a mobile market information solution that allows farmers and consumers to access market information for agricultural products (GoR, 2012). The e-Soko project won the 2011 public service delivery Technology in Government Award (TIGA) (Akinyemi, n.d.). A Land Use Management and Information System has been implemented to ensure proper usage, planning and management of land.

Private sector: ICT initiatives fostering Rwanda's private sector development include several business and career development support services; online trade information portals; business incubators; online tax calculators; credit reference bureau; a land administration and management information system; electronic case management system; and improvements in online banking and e-transaction regulatory system. These initiatives have greatly improved Rwanda's business environment. In 2010, Rwanda was the top global reformer in the World Bank's "Ease of doing business" ranking, moving up from 143rd in 2009 to 67th, the biggest jump ever recorded by any country. Online business registration was key to Rwanda's improved ranking in 2011, where it currently ranks 58th. The GoR has funded Business Development Centre - BDC (Telecenters) to support and improve the delivery of public and private sector services. Currently 30 BDCs are equipped with IT equipment and are operational (GoR, 2011c).

Health: Numerous ICT initiatives have been implemented in health such as: OpenMRS – an open-source medical records system that facilitates nationwide tracking of patient data; TRACnet – a system that allows central collection and storage of clinical health information; Mobile e- Health – a system used by community health workers to collect data for OpenMRS and TRACnet systems; Telemedicine – that is connecting King Faisal Hospital to Hospitals in Kabyagai and Musanze facilitating the sharing of clinical information between urban and rural hospitals, and most importantly allowing citizens to receive specialized treatment services remotely without travelling to Kigali. These initiatives are transforming healthcare delivery and helping Rwanda achieve Millennium Development Goals (MDGs) in health, which is earning Rwanda critical acclaim world-wide (GoR, 2011b).

Education: GoR has implemented numerous ICT initiatives in education that are transforming education. They include ICT training for primary and secondary school teachers; the One Laptop Per Child initiative; Science and Technology scholarships; the ICT Training & Research Institute at Kigali Institute of Science and Technology (KIST); Schoolnet; the Educational Management Information System (EMIS), and the Rwanda Development Gateway, an information portal including education information. University students use ICT resources like Internet and e-books to have cheap, fast and updated studies and researches, so crucial in the development of a knowledge based economy (Hennessy, et al., 2015). For example Rwandan University students follow Stanford University’s free online courses known as Udacity. Training primary and secondary school teachers on ICTs in education initiative is fully operational and is aimed at ensuring that primary and secondary school teachers are competent enough in the use of ICTs to be able to teach their students; and to ensure that teachers are knowledgeable enough in ICTs in order to enhance their teaching skills. As a result, there are now up more than 8000 teachers trained and there is evidence of improved English and ICT skills.
Speed-up the Deployment, Exploitation, and Development of ICTs in Higher Education Institutions aimed at encouraging and facilitating ICT education, training and R&D work in universities and colleges. As a result, almost all universities have computer laboratories. Special ICT in Education Programmes and Initiatives - This programme was introduced to transform the educational system using ICTs aimed at improving accessibility, quality and relevance to the development needs of Rwanda. Such initiatives include the NEPAD e-Schools programme and the KIST Academic exchanges of students with German Universities (Hakizimana, 2015).

**Businesses Transactions:** Through electronic payment systems like credit cards and sms banking, online advertising like Google ads and online shipping, businesses are meant to boom simply through use of ICT tools. For example Rwanda Development Board’s tourism department is able to attract more tourists through its Adverts on Google (U.S. Department of State, 2015).

**Information dissemination:** To have a knowledge based economy, citizens need to have access to accurate and real time information, all of which are provided by ICT tools like broadband. For example, Rwandans need to have real time updates about the Stock exchange’s daily market status in order for them to develop an efficient investment mind (RTN, 2014).

**Integration of a given economy into the global economy:** Through Internet based trading, an economy is able access a global market hence resulting into better balance of payments at the end of its fiscal year. For example, through Visa card transaction systems, a Rwandan bank account holder in Bank de Kigali is able buy a book from Amazon.com likewise sell a Rwandan locally product to anyone around the word.

**E-governance:** A knowledge economy can only be in existence when governed by an efficient government system, and as it is globally noticed, e-governance is among the tools governments use to improve efficiency. For example Rwanda courts of laws’ Internet based case filling and proceedings system is a remarkable achievement towards attaining a knowledge economy. Another example is Electronic Visa set to support and empower the Immigration and Emigration Departments in simplifying entry and exit processes, to ease in obtaining travel documents, and collect migration. The aim is to enhance immigration control services and this has been effective through the implementation of the electronic visa issuing component by the Immigration Office. The online visa application process is fully operational and those visitors who have not access to Rwandan embassy could apply for the Visa prior to their visit to the country. In addition, immigration related processes are now given tracking number enabling applicants to track their application process (Ndahiro, 2009).

**Information sharing:** Through online based forums and journals, meaningful debates about decision making and business projects development are made which gear an economy towards development. For example, COODEPAC is one of Rwandans’ online forums through which sharing of computer programming tips is done to develop solutions to local problems. The_gender_cluster_rwanda@yahooogroups.com forum is created for facilitating communication and information-sharing among stakeholders. Topics will be posted online, and partners are invited to discuss them (MIGEPROF, 2010).

**Socializing and networking:** both lead to development of a knowledge economy. Through Facebook, Google+, LinkedIn and many more online based social networks, a given economy’s people are able to easily interact with intellectuals and professionals from across the world, thus leading to development of citizens. For example through use of Internet based social networks a number of Rwandans have participated in high ranking international competitions like Google Summer Code.

**ICT Infrastructure:** Rwanda has registered significant progress in the deployment of world-class ICT infrastructure that is now connecting Rwandans to global networks. The national fiber optic backbone network that is connecting Rwanda to international sea cables will facilitate increased affordability and access to Internet across the country. A national data centre has been developed, which allows Rwanda
to centralize her information storage, management and protection, as well as take advantage of cloud computing opportunities. Communication, Navigation Surveillance and Air traffic management system (CNS-ATM) has been deployed, which will greatly transform air travel, not just for Rwanda, but the region at large (Organisation de l’Aviation Civile Internationale, 1995). Broadcasting masts that are transforming broadcasting nationally have been deployed at Rwanda's highest peak thereby fast tracking Rwanda's migration from analogue to digital. Key achievements in this sector include: (i) Kigali Metropolitan Network was completed and about 98 government institutions are already connected with fiber optic cable. The objective of the project was to provide broadband connectivity to all Government Institutions in Kigali City and further link them to the National Backbone for interconnection with all the Districts. (ii) Four telecom operators – MTN, TIGO, BSC and Airtel. (iii) SMART National ID in place. The National Data Center physical construction was also completed (RURA, 2013).

Conclusion
In order to transform Rwanda into a knowledge-based economy, GoR integrated ICT in the Vision 2020 and Poverty Reduction Strategy (EDPRS) to enable Rwanda leap-frog the key stages of industrialization and transform her agro-based economy into a service, information-rich and knowledge-based one that is globally competitive (GoR, 2000; & GoR, 2013b). The National Information and Communications Infrastructure Plan process, which is in line with Vision 2020, began with the first of four five-year rolling plans, NICI I (NICI-2005 Plan) that focused on creating the necessary enabling environment that would enable the establishment and growth of Rwanda’s ICT sector. Emphasis was placed on establishing the appropriate institutional, legal and regulatory framework, liberalization of the telecoms market, and reduction of entry barriers to the telecom market as well as an effective implementation and coordination mechanism.

The second plan, NICI II (NICI-2010 Plan), focused on providing world-class communications infrastructure that will serve as the backbone for current and future communications requirements. At that day, Rwanda enjoys increased nationwide coverage of telecommunication networks, has deployed a versatile and high capacity national optic fiber backbone network, and a national data center. Rwanda is now well positioned to become a regional ICT hub that can offer a wide range of competitive ICT products and services.

The third plan, NICI III (NICI-2015 Plan), focused on the development of services by leveraging ICTs to improve service delivery to citizens, as Rwanda approaches the fourth and final phase of the NICI process that will propel Rwanda to achieve Vision 2020 goals. In this phase, emphasis was been placed on the development of services in the following five focus areas: (i) Skills development aims to develop a high quality skill and knowledge base leveraging ICT; (ii) Private Sector Development aims to develop a vibrant, competitive, and innovative ICT sector/ ICT enabled private sector; (iii) Community Development aims to empower and transform communities through improved access to information and services; (iv) E-Government (e-GOV) aims to improve government operational efficiency and service delivery; (v) Cyber Security (CS) aims to secure Rwanda’s cyberspace and information assets. These focus areas will accelerate services development and fuel continued growth (GoR, 2015).

By those efforts, in 2010, Rwanda became the top global reformer in the World Bank Doing Business report and second global reformer out of 183 countries in 2011. Rwanda is also the 9th easiest place to start a business in the world and the 6th most competitive economy in Sub-Saharan Africa according to the 2010 World Economic Forum global competitiveness report. This has largely been a result of several reforms including online business registration, aimed at making the business environment more conducive. Rwanda’s real GDP growth increased from 2.2% in 2003 to 7.2% in 2010, and an overall average GDP of 7%. These achievements are a result of the long-term economic development plan, Vision 2020, its medium-term strategy, the Economic Development Poverty Reduction Strategy (EDPRS), and the NICI Plan, which all give a clear direction on how Rwanda will transition from poverty to a middle-income, knowledge-based economy.
Recommendations

To Government
- To attract private investment and create a skilled labor force that can take advantage of Rwanda’s competitive, business-friendly policy environment.
- To augment the number of ISP and ICT services providers.

To Private Sector
- To target countryside areas and supply ICT4D facilities.

To Rwandans
- To profit at maximum all ICT4D services available and engage themselves in oneself and community development.

Suggestions for further studies
The present research on ICT4D as a driver of Social Economic Development in Rwanda has considered the period 2000-2015. It aims to describe the evolution of ICT and its impact on lives of Rwandans. Further studies would analyze sector by sector with more details how really ICT4D affected Rwandans’ lives.

References


