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An examination of the relationships between the transfer of information and communications technologies and capacity building towards sustainable development of small and medium enterprises : A focus on Rwanda and Tanzania

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Declaration

I declare that the thesis, which I hereby submit for the degree Philosophiae Doctor (Technology Management) at the University of Pretoria, is my own and has not been previously submitted by me for a degree at another University

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Abstract

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In the modern era, it is widely acknowledged that information and communication technologies have become foundational to every aspect of human endeavor and well-being. The policies of private and public sector organizations, and more so of governments of sovereign states, emphasize the deployment and utilization of information and communication technologies in virtually all forms of business activities. Comparatively, there is consensus that economic and social development of countries can be highly dependent on small and medium enterprises. A broader question arises as to how information and communication technologies can be combined with small and medium enterprises to accelerate sustainable development, especially in nations classified as least developing countries. This research provides some empirical evidence on the extent of the triangular correlation between the transfer of information and communication technologies, capacity building of small and medium enterprises for sustainable development in the least developed country context. The study provides useful insights for policy making with regards to leveraging small and medium enterprises plus information and communication technologies towards stimulating and accelerating sustainable development of least developed countries.

Keywords: information and communication technology, capacity building, sustainable development, small and medium enterprises, least developing countries.

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3G	Third Generation
ACE	Africa Coast to Europe underwater cable
AISI	African Information Society Initiative
AMIS	Agricultural Management Information System
AS	Application Service
AU	African Union
BDS	Business Development Services
BoP	Balance of Payments
BRELA	Business Registration and Licensing Agency
BRICS	Brazil, Russia, India, China and South Africa
CB	Capacity Building
CD-ROM	Compact Disk – Read Only Memory
CLF	Converged Licensing Framework
CNS-ATM	Communication, Navigation Surveillance & Air Traffic Management
CS	Content Services
CSR	Corporate Social Responsibility
DTBi	Dar Teknohama (ICT) Business Incubator
EAC	East African Community
EASSy	East African Submarine System underwater cable
ECA	Economic Commission for Africa
EDPRS	Economic Development and Poverty Reduction Strategy
EIG	Europe India Gateway underwater cable
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GoK	Government of Kenya
GoR	Government of Rwanda
GoT	Government of Tanzania
GSMA	Global System for Mobile Association
HCI	Human Capital Index
HLI	Higher Learning Institutions
ICT	Information Communication Technology
ICT4D	Information Communication Technology for Development
I-ME-WE	India-Middle East-Western Europe underwater cable
IP	Intellectual Property
IPRs	Intellectual Property Rights
IT	Information Technology
ITT	Information Technology Transfer
ITU	International Telecommunications Union
KE	Knowledge Economy
KIPC	Korean Informatisation Promotion Committee
KIST	Kigali Institute of Science and Technology
KWH	KiloWatt per Hour
LDC	Least Developed Country
LION	Lower Indian Ocean Network underwater cable
MDA	Ministries, Independent Departments and Government Agencies
MDG	Medium Development Goals
NEPAD	New Economic Partnership for African Development
NICI	National Information Communication Infrastructure

NF	Network Facility
NGO	National Government Organisations
NS	Network Service
OECD	Organization for Economic Co-operation and Development
PPP	Public Private Partnership
PSF	Private Sector Foundation
PSTN	Public Switched Telephone Network
R&D	Research and Development
RDB	Rwanda Development Board
RITA	Rwanda Information Technology Authority
RPED	Rural Programme on Enterprise Development
RURA	Rwanda Utilities and Regulatory Agency
RWF	Rwandese Franc
SAFE	South Africa Far East underwater cable
SAS1	Saudi Arabia – Sudan 1 underwater cable
SD	Sustainable Development
SDG	Sustainable Development Goals
SEA-ME-WE-4	South East Asia-Middle East-Western Europe 4 underwater cable
SEACOM	South Africa, Madagascar, Mozambique, Tanzania, Kenya, India and Europe underwater cable
SET	Science, Engineering and Technology
SEZ	Special Economic Zone
SIDO	Small Industries Development Organization
SIM	Subscriber Identity Module
SME	Small and Medium Enterprise
STI	Science, Technology and Innovation
Tbps	Terabits per second
TCRA	Tanzania Communication Regulatory Authority
TEAMS	The East African Marine System underwater cable
TFP	Total Factor Productivity
TIGA	Technology in Government Award
TT	Technology Transfer
UN	United Nations
UNESCO	United Nations Education and Scientific Council
USA	United States of America
VOIP	Voice Over Internet Protocol
WASC	West Africa Submarine Cable
WESP	World Economic Situation and Prospects
WB	World Bank
WIBRO	Wireless Broadband
WTDC	World Telecommunication Development Conference

Chapter 1 Introduction

1.1 Technology and Industrialization

Since the beginning of time, innovation has enabled mankind to evolve from the stone-age, through the industrial age to the current information and communications propelled era of economic and social development. Technology has always played a crucial role in developments in human society, as evidenced in the industrial revolutions of the 18th and 19th centuries. Technology enabled industrialization such as manufacturing intensified the use of technological machines. The use of technological machines embodied the adoption and use of new and improved technology that brought about socio-economic development in the community. Communication improved during the era of industrial revolution with such inventions as the telegraph. Conditions for the working-class began to gradually improve by the later part of the 19th century, as governments instituted various labor reforms and workers gained the right to form trade unions. In the mid-19th century, industrialization was well-established throughout the western part of Europe. By the early 20th century, the United States had become the world's leading industrialized nation attributable in part to, policies and regulations which encouraged exploitation of knowledge and capacity building for rapid deployment and management of industrialization technologies. Industrialization of technologies means that a product can be produced at a constant or increasing returns based on the scale of inputs, which enhance efficiency in the utilization of knowledge and resources. In a manner similar to the spread of industrialization in developed countries, the ubiquitous and pervasive nature of information and communication technologies should also enable least developed countries (LDCs) to fast track development.

According to Dzisah and Etzkowitz (2008:2), the knowledge-based society, has raised the bar of industrialization such that instead of focusing solely on the manufacturing of tangible objects, the emphasis has shifted to the capitalization of knowledge as the basis for economic and social development. This implies that the industrial revolution factors of the 18th and 19th centuries have been replaced by knowledge as the prime factor of modern era productivity. Developed economies utilize knowledge-based intangible assets that are applied in the production of goods and services. The intangible forms of knowledge appear more pronounced as today's society undergo sweeping changes in terms of the many facets of

globalization, economic and socio-political revolutions, all of which are being fuelled by information and communication technologies.

1.2 ICTs and Globalization

ICTs have become a defining characteristic of 21st century globalization, and dominate systems of innovation in both international and national spheres. ICTs are a cornerstone of modern society, wherein all sectors of human endeavor are critically linked. ICTs have diminished the shortcomings of early industrialization and have produced new opportunities including investment in training a skilled human resource (Orhan and Zeytinli 2009 :846). Steinmuller (2001:193) contend ICTs compliment modern production capacities. ICT has become indispensable to improving organizational efficiency, enhancing national competitiveness, and increasing the profitability of the manufacturing, financial, medical, and entertainment industries all over the world. ICTs are unique when compared to legacy tools and processes that facilitated the pre-20th century industrial revolution. According to Ho (2007:1), ICT is considered the prime factor behind the unexpected economic growth period of the past decade. ICTs knowledge is reasonably explicit and structured thereby making them relatively easier to deploy in industry. The ICT technologies manifest themselves in many physical and tangible artifacts (see, for example, Rao (2009:130)) which feature highly embedded computational capabilities and progressively reduced energy consumption (Koomey, Berard, Sanchez and Wong (2011).

The foundation of the modern era concept of knowledge-based economy that utilizes ICT is research and development (De Bode, 2015) and underpinning that foundation is the use of *'information', 'knowledge',* and '*technology'*. Note that '*knowledge*' encapsulates facts, information and understanding accumulated over time. In addition, '*technology*' often refers to means, methods, processes, and techniques of utilizing knowledge to enhance or modify the environmental ecosystem, or to create items that satisfy human needs, or to solve actual and perceived problems encountered by human beings. ICT provides the means for knowledge-based transformation and development of countries irrespective of their classification.

1.3 Developmental Classifications of Countries

Countries of the world are classified into (a) developed economies, (b) economies in transition, and (c) developing countries (WESP, 2014:144). Some subgroups of developing countries are further classified as least developed countries (LDCs) based on low gross national income threshold, low human assets index, as well as high economic vulnerability index. Least developed countries are defined as low-income countries suffering from organizational obstructions to sustainable development and a population not exceeding 75 million (United Nations DESA, 2017). Currently, the following criteria are used to identify LDCs (United Nations DESA, 2017):

- Low-income - measured by an average income per person over three years. An average income of less than US$745 per person per year is considered for inclusion, and above US$900 for graduation.
- Weak human resources - measured by indicators of nutrition, mortality of children aged five years or under; secondary school enrolment; and adult literacy rate.
- High economic vulnerability- measured by population size; remoteness; diversity of goods exported, share of agriculture, forestry and fisheries in the economy; instability of agricultural production; instability of exports of goods and services; and homelessness owing to natural disasters.

Figure 1 shows a map of LDCs as of 2015. A majority of the countries are in Africa.

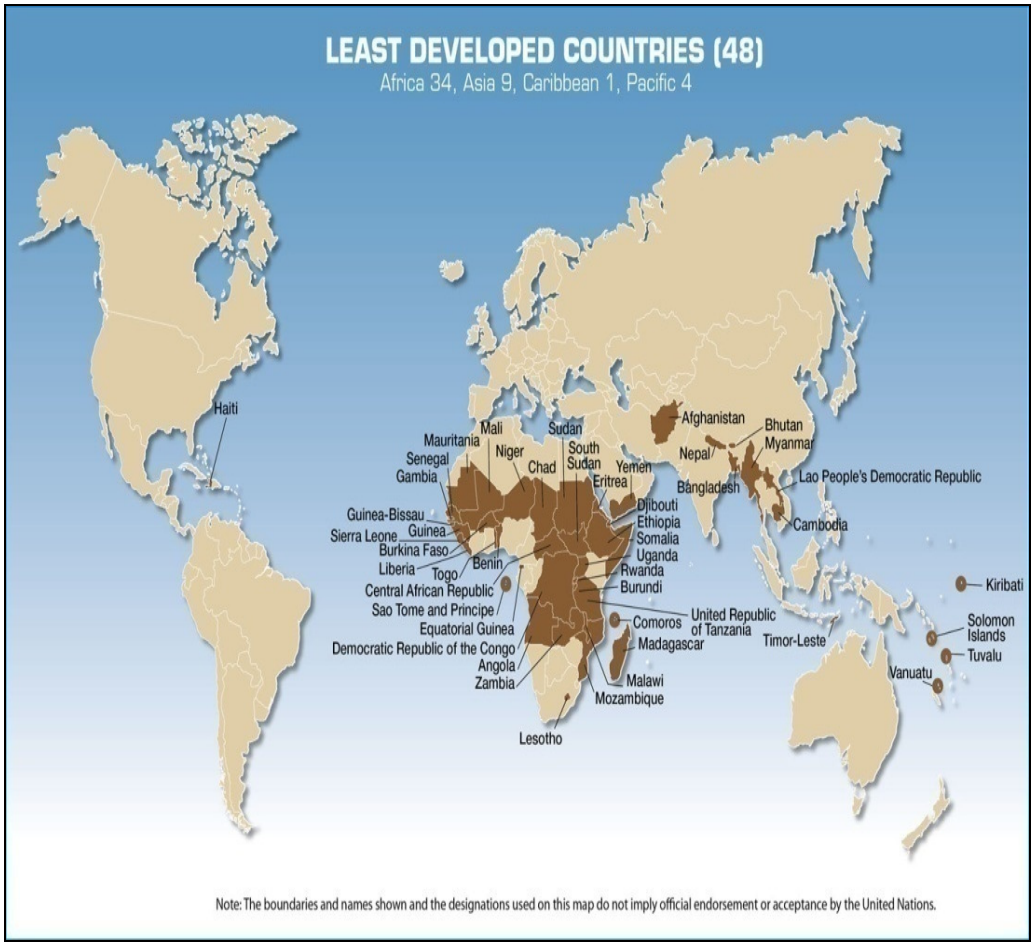


Figure 1: Map of least development countries
Source: http://unctad.org/en/PublishingImages/LDC_map_1500x936.jpg

In the global economy, which is getting to be more technology and information demanding, LDCs seem to be at a disadvantage, as extrapolated from the identification criteria. LDCs inability to effectively participate in the globalization process is impacted by the uneven distribution of resources, like skills and telecommunications. Ogunsola (2006:140) state that globalization favours those countries with technology, resources and access to markets. Least developed countries are confronted with serious challenges of limited capacity and capability to improve on productivity. Although some LDCs exhibit remarkable growth rates albeit from a very low base, however, they encounter structural challenges with regard to the development and exploitation of knowledge of information and communication technologies (ICTs).

1.4 The Digital Divide

Whereas infrastructure challenges, access to information and digital literacy disparities have accentuated a form of digital divide between developed and least developed countries, however, globalization has forced open most economies such that less developed countries are benefiting from technological innovations sourced from developed nations. Unfortunately, this has concomitantly widened the gap between rich and poor countries and Narasimha (2008:1) briefly outlines the disruptive effects by using India as an example. He writes that the rapid expansion of science and technology infrastructure on India's economic structure has exacerbated the inequalities in terms of prosperity and income. The suggestion is that the technological development gap between the less developed poor nations and the developed nations will increase if the technologically poor nations do not get the opportunity to "leapfrog" as the developed nation advance their technological capabilities.

Deursen and Dijk (2010:908) have a narrow definition of the digital divide as "the gap between people who have and do not have physical access to computers and the internet", however, the wider definition of the term refers to varying patterns of usage and accrual of benefits associated with information and communication technologies. The divide more or less manifests certain *stare decisis* processes that inadvertently determine *apriori* that some countries become sources while others remain recipients of ICTs. Van Dijk and Hacker (2003:320) highlight four barriers prevalent in digitally poor countries:

a) The lack of ''mental access'', which refers to a lack of elementary digital experience;
b) The lack of ''material access'', which means a lack of possession of computers and network connections;
c) The lack of ''skill access'', alluding to a lack of digital skills; and,
d) The lack of ''benefits and usage access'', which signifies the lack of meaningful usage opportunities.

In explaining the barriers, material access refers to the availability of ICT hard and soft equipment and the usage of these ICT devices and applications. Usage and skills access refers to the capacity needed for operating the ICT hard and soft equipment, including applications, for creating eContent, and for engaging in online collaboration. Benefits and usage access refers to ICT use that supports and aids the person and community in the nation. The suggestion is that in poor countries with meager economic capital, the people may not afford

and hence may be more impaired to access ICTs, or even to develop the requisite capabilities to utilize ICTs.

Least developed countries, especially those in Africa, face enormous challenges in their ability to utilize these ICT resources for their growth and development agenda. Limitations that range from infrastructural constraints to limited access are exacerbated by policies and regulations that may not be conducive to the uptake of ICT in these countries. As the world becomes a global village, policies that focus on sustainable development become precarious and require special attention with a high degree of priority, particularly for the LDCs.

1.5 ICTs and strategy of leapfrogging

High productivity growth in the ICT-producing industry, driven by Moore's law[1], has resulted in considerable price decreases which have enabled a rapid diffusion of ICT-products. ICTs can play a crucial role in delivering innovative, integrated, cross-sectoral sustainable development outcomes and achieving the United Nations Sustainable Development Goals. (Earth Institute, 2015:12). ICTs have an intrinsic value for long-term sustainable development and the development of ICT infrastructure creates an enabling environment required to implement the new sustainable development agenda. Making ICTs universally available can deliver important cross-cutting synergies across different sectors (Rawls, 2016:36).

There is a gap between industrialized and developed countries in the processes of human capabilities and fixed investments and this gap can be narrowed quickly through leapfrogging with the use of ICTs (Fong, 2009:3707). The pace of technology penetration is illustrated in Figure 2 for internet use and mobile phones. Not only is the change substantial, adoption is widespread and holds promise to benefit people around the world. Many technologies are in some sense universal machines that have applications in all aspects of governance as well as in production, manufacturing, and services industries. In the same vein, ICTs combine with and reinforce globalization, and are transforming how people live and work, creating new opportunities and business models, driving growth and socio-political evolution, and changing the comparative advantage of countries.

[1] Moore extrapolated that in relative terms, there would be q decrease in cost and computing increase in power exponentially

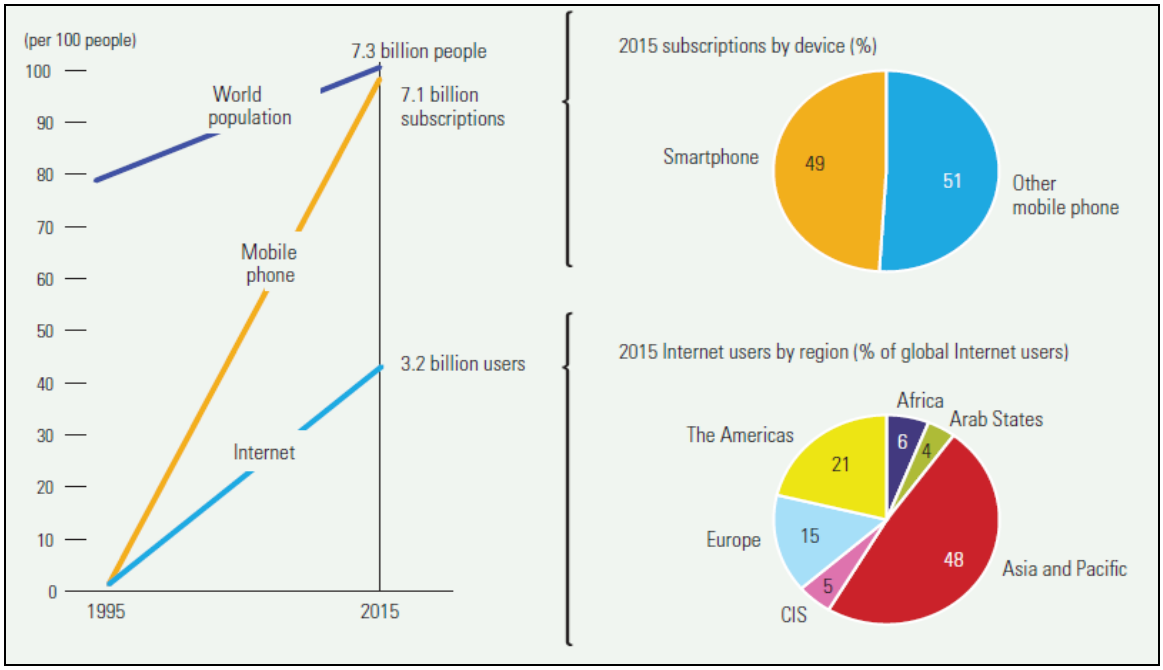


Figure 2: Change in technology penetration between 1995 and 2015
Source: Human Development 2015 Report.

The trajectory of changes depicted in Figure 2 supports the view that the internet seemingly permits boundless information flow, with wide ranging implications on human society. In essence, ICTs can enable countries to "leapfrog" technology gaps for their economic and socio-political development.

1.6 ICTs for development

There is consensus that ICTs have changed the way in which information and knowledge are created, reconstructed, arranged and distributed. ICTs facilitate the way in which technological knowledge is processed and communicated, and the marketing of associated products and services provided. Since the late 1990s there have been harmonized endeavors in Africa to implement and use modern ICTs more effectively to enhance economic development. In 1996 the Economic Commission for Africa (ECA) initiated the African information society initiative (AISI).

A goal of the AISI is develop Africa's information main corridors and to look into the use of ICTs for economic improvement on the continent. Thus African countries were assisted o

develop national information and communication infrastructure (NICI) plans. Barka (2004:7) reports that more than 30 countries in Africa have developed NICI plans to make certain that good ICT policies and strategies are put in place. The establishment of the New Economic Partnership for African Development (NEPAD) in 2001 signified the African Union (AU) specific intention to address poverty challenges, economic marginalization, and accelerated empowerment of women on the African continent. A priority of NEPAD has been to build and improve infrastructure including ICT (NEPAD, 2004:13)..

1.7 SME growth and typology of barriers to growth

Growth of SMEs generally goes through four phases according to Hui-Hong and Kim (2004: 197). This life cycle model has the following phases:

(a) Conception and idea development of start-up - the phase where design and product development occurs, and funds for development are sought;
(b) Expansion through commercialization - the phase where the product is in the market and generating revenues, and capabilities to produce products are possible;
(c) Maturity and growth - the phase where there is demand, sales and marketing being conducted at a high growth rate and SME generating profits; and,
(d) Diversification and stability - the phase where new diversified products are produced, new funds secured for scaling-up and new geographical areas and customers are got.

These phases inform on the SME growth model as they strive to transform themselves from being informal to formal SMEs that have an impact on the national economy. Unfortunately, there is a myriad of barriers to growth. Clemens, Lutz and Kemp (2010:21) identify seven impediments under two typologies as barriers to growth - structural and strategic: The structural classification includes: access to distribution; access to knowledge, skills, technology and intellectual property; capital, financial risk and government regulations. With regards to strategic classification, it includes: pricing; having asymmetric information; collusion from competition; securing appropriate strategic resources for vertical and horizontal integration to produce viable products; packaging with differentiation; distribution channels and R&D. SMEs in LDCs face these barriers as they go through the mentioned growth path.

1.8 Problem statement and research question

Many policy constructs in countries striving to leverage on SME utilization, emphasize the crucial role that SMEs can and should play in economic and social development. For example, SME policy is a an important element for enhancing competitiveness in Morocco through planned steps: the National Pact for Industrial Emergence, Vision 2020 to promote Morocco as a tourist destination and Maroc Numeric 2013. Israel created a Small Business Agency to lead the harmonization of SME activities and increase the profile of SMEs. The Ministry of Industrial Development and Investment Promotion has become the focal point entity in Algeria, tasked with raising awareness of the SME policy. Jordan is in the process of adopting a National Strategy for Micro, Small and Medium-sized Enterprises for 2014-2018. (OECD, 2014:14). Similarly, science and technology policies in some LDCs also mention the need for ICTs. As an illustration, Mongolia has developed a Science and technology master plan
so as to optimize and foster the science and technology (S&T). Also, it is advancing innovation areas meeting the market needs, in order to develop knowledge, to quickly commercialize and work into the economy the results and intellectual properties created. (Government of Mongolia, 2007:25).

Lesotho has a S&T policy that forms a national strategy to increase GDP activities, and to change domestic savings into real domestic investments, employment and to have value addition in local production. (Government of Lesotho, 2006:25). Another example is Lebanon and its science, technology and innovation policy. The objective is to create high quality jobs and investment opportunities to mitigate the brain drain. Another goal is to strengthen the economy, improve the quality of life and help Lebanon join the worldwide trend towards becoming a knowledge-based society. (Government of Lebanon, 2006:60).

Having stated the above general issues, the policies of the East African countries tend to be developed in isolation. There is little evidence to indicate that empirical data has been used to enhance integration or linkages in the development of the policies supported by knowledge transfer that require use of ICT. All these countries have a nission and vision to become middle-income knowleadgeable socities. ICT can be considered to be an enabler as well as a tool that can spur economic growth. Capacity building and sutainable development are

crucial "ingredients" for such growth. Unfortunately, the current policies and strategies of each of the East African countries are developed in "silos" without acknowledging the linkages between ICT transfer, capacity building and sustainable development. The same countries are emphasizing job creation generted by SMEs. This suggests a gap in knowledge required for policy and strategy development. Starting with a primary proposition that ICTs influence all aspects of human endeavor, then, by extension, ICTs affect capacity building of SMEs for sustainable development. Thus, a main research issue is to examine whether or not a triangular correlation exists (and if so, to what extent) between the transfer of ICTs, capacity building of small and medium enterprises for sustainable development with reference to Rwanda and Tanzania. .

The unit of analysis in this study is SMEs, albeit that the research examines the presumption of triangular correlation between ICT transfer factors, capacity building factors and sustainable development factors.

1.9 Research objectives and limitations

A primary objective of the research is to explore the extent of triangular correlation between ICT transfer, capacity building of SMEs for sustainable development. The goal is to provide useful insights for improving many policies that impact economic and socio-political development in LDCs. With a bias toward policy making, the study focused on sustainable development of small and medium enterprises in Rwanda and Tanzania. Although case study reviews of ICTs and SME developments in South Korea, India and Kenya are included, however, primary data was obtained from respondents in Rwanda and Tanzania between 2012 and 2016.

1.10 Structure of the thesis report

Chapter 1 has provided an introduction and background to the research study. Chapter 2 describes the literature study on ICT transfer, capacity building and sustainable development in relation to LDCs and SMEs. Chapter 3 discusses ICTs in Africa with a focus on Rwanda and Tanzania. This is followed by brief case studies of South Korea, India and Kenya. The conceptual model of the research is described in Chapter 4 highlighting the factors of ICT transfer, capacity building and sustainable development as extracted from the literature study.

Chapter 5 discusses the collection of both qualitative and quantitative data. Chapter 6 includes analysis of empirical data and presentation of the results. The conclusion, implications, and recommendations of the research study are included in Chapter 7.

Chapter 2 Literature Study

Many studies have analyzed the propinquity between ICT and economic performance, which examine its effects on firm profitability. (Indjikian and Siegel 2005:687). The following Figure 3 illustrates some of the studies.

Author(s)	Methodology	Country/sector	Level of aggregation	Results
Dunne *et al.* (2000)	Regressions of labor productivity on computers	USA/manufacturing	Plant-level	Positive association between computers and labor productivity, which appears to be growing over time
McGuckin and Stiroh (1999)	Cobb–Douglas production function with computer capital	USA/manufacturing and service	Aggregate, major sector, and 2-digit SIC industry-levels	Evidence of "excess" returns to computer capital at each level of aggregation
Gera *et al.* (1999)	Cobb–Douglas production function with computer capital	USA and Canada/ manufacturing	Industry-level	Positive correlation between investment in computers and labor productivity growth
McGuckin *et al.* (1998)	Regressions of labor productivity on dummies denoting whether the plant uses a computer-based manufacturing technology	USA/manufacturing and service	Plant-level	Plants using advanced computer-based technologies have higher levels of productivity; weaker evidence on the relationship between technology usage and productivity growth
Lehr and Lichtenberg (1998)	Cobb–Douglas production function with computer capital and labor	USA/public sector	Organizational level (government agencies)	"Excess" returns to computer capital
Siegel (1997)	Latent variables model: regressions of parametric and nonparametric measures of TFP growth on the rate of investment in computers	USA/manufacturing 4-digit SIC	Industry-level	When controls are included in the model for measurement errors, computers have a positive and statistically significant impact on productivity

Figure 3: Some studies on ICT and economic performance
Source: Indjikian and Siegel (2005)

Indjikian et al observe there is a positive link between some agents for IT investment and some agents for economic performance at each level of aggregated objective (e.g., factory, industry, and nation). Although many of the observed results are derived from developed economies, the results provide important lessons for the least developed countries. With that in mind, Indjikian et al recommend the policymakers address an important matter in order to stimulate higher social returns to investment in ICT.

Most important is the lack of understanding of ‘‘best practices’’ in the use of ICT by SMEs: LDC governments should put in place a framework for the uptake of knowledge by local firms and SMEs on the best methods of using ICT in their respective sectors, so that the most effective choices can be made using this technology. The applications associated with ICTs remain an expensive investment for companies and SMEs in developing countries, as the

need is beyond just connecting to the internet and global markets or networks. Indjikian et al note that there is a need for ICT capacity absorption to be used by firms in a way that does not increase unnecessary costs between buyers and sellers of products.

2.1 A review on ICT trends, with a focus on the ubiquity of ICTs

Most times, ICTs are linked with computers and the internet, with not one agreed upon definition of ICT. Flor (2008:20) writes that ICT refers to new generation technologies spawned by the marriage of computers, telecommunications and associated products and services. ICTs result from the convergence of "technological tools and resources used to transmit, store, create, share or exchange information" (Elsag 2002:8). The potential to improve the standard of living and enhance the well-being of citizens is borne out of the fact that ICTs cut across all sectors of the economy and all fields of human activities, from telecommuting to work to business teleconferencing to collaborative research across national boundaries (UNESCO, 2009:120). There has been a paradigm shift towards software-driven technologies in the uptake of ICT. Figure 4 illustrates some paradigm shifts, technology trends and technology change over time.

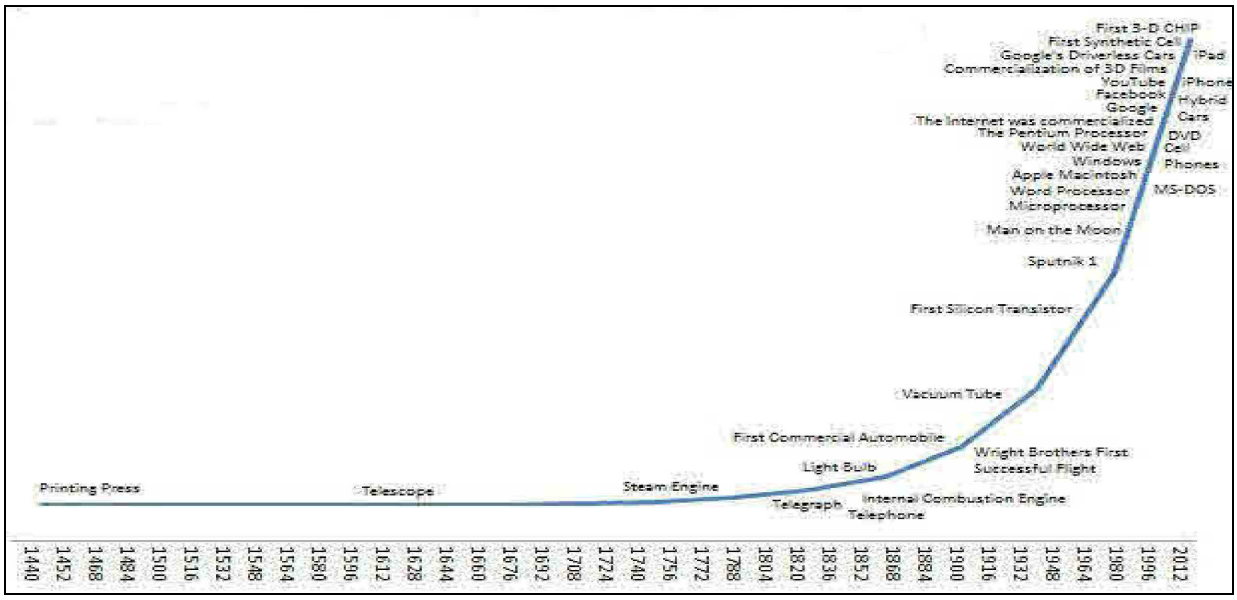


Figure 4: Technology change over time
Source:
https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=imgres&cd=&cad=rja&uact=8&ved=0ahUKEwjJ84WJ9svRAhVKnBoKHWjEAHMQjRwIBw&url=http%3A%2F%2Fseekingalpha.com%2Farticle%2F453871-the-promise-of-accelerating-growth-in-technology&psig=AFQjCNGEuVD-Sigh9XiWQW_PcV4Yx97xog&ust=1484836747469798

Figures 5 illustrate Gartner's postulation on the hype cycle for technology growth and expectations with time.

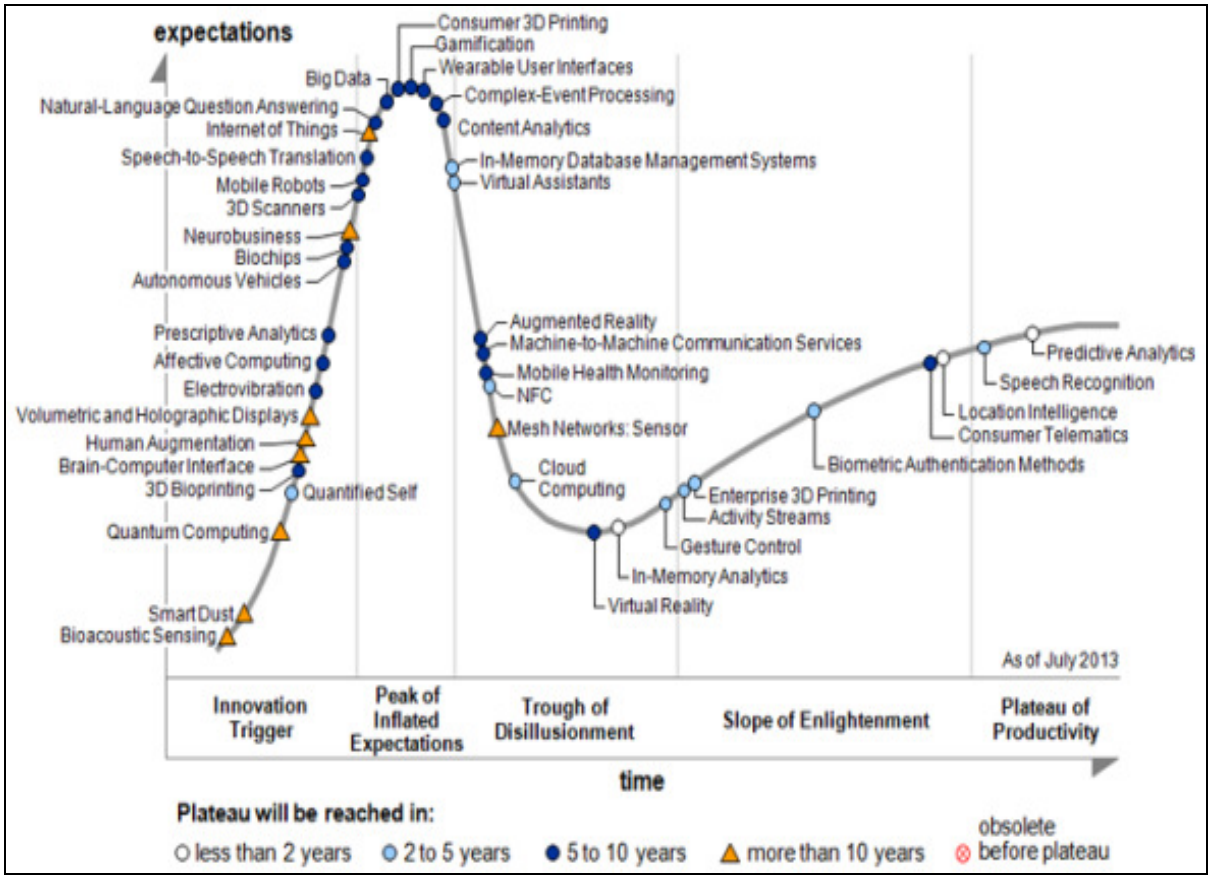


Figure 5: Technology growth expectations with time
Source: http://thirdstreamresearch.com/?p=1

The trajectory of different technologies increases with time and in this regard, developing economies, particularly those in Africa, may not have the absorption capacity, and as a result face daunting challenges to manage technology. An extrapolation from Dosi (1982:151) suggests that capacity building follows the direction or trajectory of technological change. Some of these challenges include the way in which human capital is managed. For example, in modern factories, it is software that creates inventory for materials to be ordered at the lowest possible cost and arranges for just-in-time delivery, meaning human knowledge is most likely measured in bytes stored in the computer systems.

Access to the simplest form of ICT Infrastructure is the foundation and start to increasing the flow of information and enhancing communications. Alumanah (2006:4) proposes that ICT is

increasingly fundamental to social and economic development. Misuraca (2009:84) states that the use of ICTs offers great possibilities for raising the standard of living, not discounting for example, the impacts on politics, governance, infrastructure, and basic literacy. Although many technologically disadvantaged LDCs believe that ICTs could foster faster economic development, however, Plane and Venter (2008:309) observe that each country will progress at a trajectory and pace determined by its own unique circumstances. The implication is that any generalized approach must be refined for each source/recipient relationship so that technology transfer can occur along a properly defined path, cognizant of the limitations that would be imposed by cultural differences. When basic technologies in the right cultural context are transferred to solve problems in the recipient's environment, meaningful and sustainable development is possible creating the impetus for more advanced technologies to be embraced (Musa, Mbarika and Meso 2005:114). Also, a major part of the exploitation of suitable technologies by a developing economy is dependent on the capacity of human and institutional structures to adapt to the complexities inherent in technological innovations. According to Musa, Mbarika and Meso (2005:1142005:114), the transfer of technology depends on:

- The level of the existing stock of knowledge,
- Absorptive capacity; as well as
- The policy, legal and institutional frameworks of both the source and recipient economies.

Pade, Mallinson and Sewry (2006:101) point out that ICTs embedded in entrepreneurial activities, markets, education, knowledge and health systems can promote sustainable rural livelihoods. ICTs are reshaping many aspects of the world's economies, governments and societies (World Bank, 2014). In least developed countries, governments, businesses and people are harnessing the transformative power of ICTs to make public services more efficient, strengthen social networks and enable development of small and medium enterprises (SMEs). The economic benefits of ICT can be direct, through increases of employment and demand, and can also be indirect, notably through social returns (Andrianaivo and Kpodar, 2011:6). In Table 1 below, channels of transmission that impact growth are shown:

Table 1: Transmission Channels from ICT to Growth

Direct effects of ICT	Indirect effects of ICT
From supply side	From ICT use
• Contribute to domestic output and employment creation	• Spur capital accumulation
• Increase government revenues	• Improve firms' productivity
• Affect balance of payments	• Favor better and larger markets
	• Deepen financial inclusion
	• Contribute to rural development

Source: ICT, Financial Inclusion, and Growth: Evidence from African Countries-IMF Working Paper

Hopwood, Bill, Mary Mellor, and Geoff O'Brien (2005:18) emphasize that active partnerships among the private sector and public sector can increase the amount of available resources for sustainable development. With the ongoing globalization of economies, multinational corporations tend to be responsible for most of the technology transfer through foreign direct investment (FDI) and international trade. Hermosilla and Martinez (2009:2) point out that technologies deployed by transnational companies in emerging economies often cause significant impacts in the host countries. They observe that technological know-how may be concentrated in developed economies, thus exposing developing economies to dependence and subjective monopolies, which often imposes inappropriate technological solutions to unique developmental problems. Avgerou (2010:6) posits information communication technology as an enabler of transformation and development, specifically highlighting its positive, creative and catalytic effect on economic opportunity, empowerment and participation by the public and private sector. Punie (2007:188) points out that ICT technological trends contribute to changing and knowledge economy through infrastructure and hardware convergence. This includes broadcast, media, phones, data, networks and wireless technologies. In a knowledge-based economy, these trends require investments to be made in human resources and high-technology areas so that the knowledge that is transferred to LDCs is adapted to fit the local production needs.

2.2 A discourse on Technology Transfer issues

Lema and Lema (2012:24) state that technology transfer is widely defined as the process showing the flows of equipment, know-how and experience among partners (individuals, institutions, and enterprises) to increase at least one partner's knowledge and expertise.. Andersson and Norrmalm (2010:8) define technology transfer as "*the knowledge, skills, methods and procedures generated and developed in one location and transferred to another, where it is used to achieve some practical end*." Technology transfer (TT[2]) consists of a "transfer" of technological knowledge, including a "transfer" of the capacity to assimilate, implement, utilize and further develop a technology. Irwin (1998:2) writes, "*Technology transfer occurs at all stages of the technology innovation process, from initial idea to final product…these processes integrate multiple functions, including organized research and development, design, production engineering, manufacturing, marketing, and other value-adding activities in a complex web containing multiple feedback loops*." Economic growth will not be influenced by technology transfer alone, but the capacity and ability to utilize appropriate technology may be the catalyzing factor. Various technology transfer factors can have direct or indirect impact on technological capability. These factors include: the general state of the economy, policies and strategies a government has with regards to investment, state of national technological infrastructure and the value placed on technology transfer from a social attitude or receptiveness aspect (Nissanke, 2006:9).

Technology transfer adaptation has the ability to influence the creation of progressive applications. The process of learning how to use and maintain the technology is as crucial as learning to adapt the technology to local conditions. Two types of ICT applications can be distinguished: progressive and transformational. Heeks (2010:14) writes, "*progressive applications are those that deliver substantial impacts e.g., the creation of new income or new capabilities through ICT but which do not change the underlying mechanisms and structures of development.*" Transformational applications can reconstitute the mechanisms and structures of technology adaptation, and may introduce an entirely new business model framework. A technology is itself progressive thus the challenge of technology transfer is the capacity absorption of the recipient entity to learn the technologies that are constantly

[2] TT is used interchangeably with ICT transfer in this report

evolving. Technologies, especially those of computing, are characterized as 'pervasive' if they become an essential commodity that is accessible in all sectors of the economy (Dhir, Jere, Kaur, Heiskala, Albidewi, and Alghazzawi 2012:925). A technology process can have economic effects and job creation implications if it has the following impacts: new services and products are created; cost reduction and improved performance in services across various economic sectors when utilizing the technology process; and, the technology process getting social acceptance.

Al-Mabrouk and Soar (2009:5) present a useful method by which the skills and technologies that are transferred – as well as the process in which the transfer takes place – can be understood and analyzed. Al-Mabrouk and Soar (2009:5) argue that the IT transfer process should be seen as a dynamic and logical structure split into stages, ranging from assessment and selection to the actual development of the imported IT. Figure 6 shows the IT transfer (ITT) process from developing countries to recipient Arab countries.

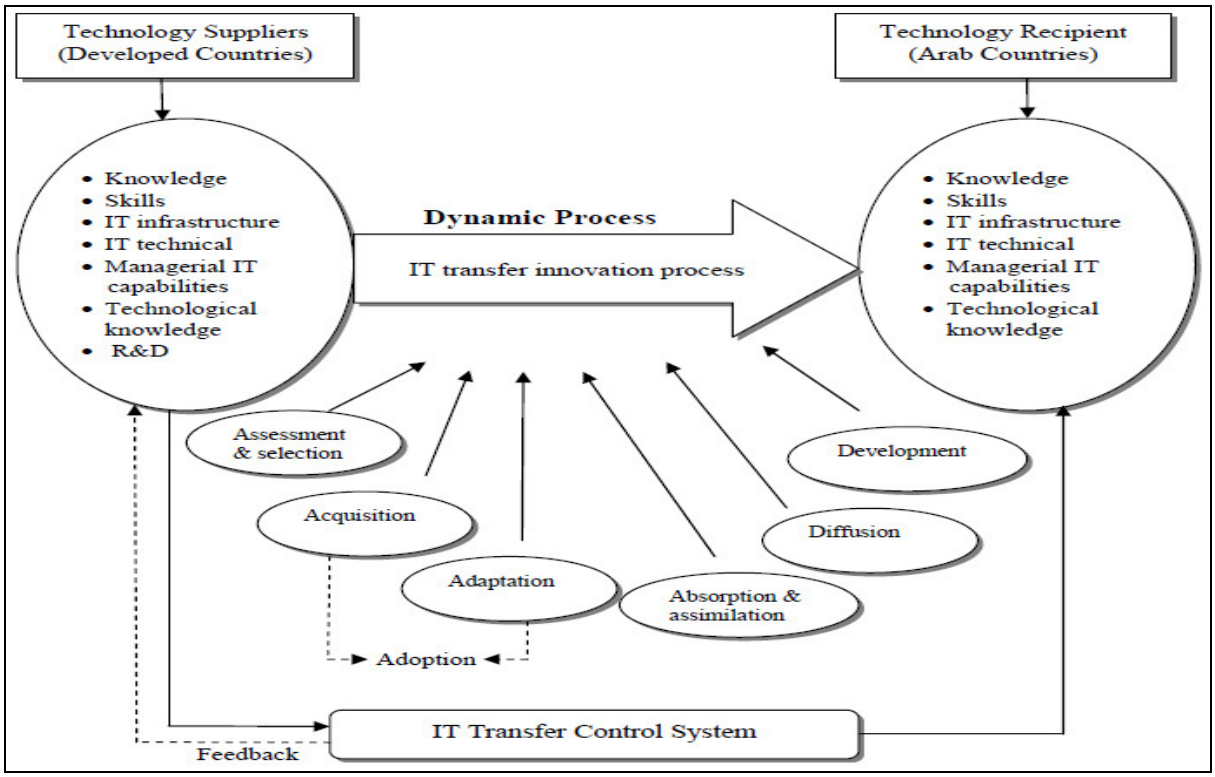


Figure 6: The ITT model
Source: https://eprints.usq.edu.au/4953/1/Al-Mabrouk_Soar_1.pdf

When technologies are transferred to solve problems in the right cultural context of the recipient's environment, meaningful and sustainable development is possible thus creating

the impetus for more advanced technologies to be embraced (Musa, Mbarika and Meso, 2005:112). To have a proper process of technology transfer/diffusion, Lechman (2013:3) advises it should encompass four aspects, namely: *innovation* (an idea, practice or project seen as new), *communication channels* (process in which involved stakeholders can create and exchange information), *time* (an element determining the strength of the process), and *social system* (a set of interconnected units). The key component in the above is the social system, as the inherent interconnection allows the adoption of the technology to occur at an individual level, taking into account the local context and culture. Lechman (2013:3) concludes that ICTs can play a crucial role in the development process when technology transfer is effected in a manner that broadens access to knowledge.

The African Development Bank has taken a general approach to supporting LDCs in Africa in ICT transfer for development, writes Yahiaoui (2009:21). The approach takes into account the flexibility in ICT investments at national and regional levels with focus on broadband infrastructure, usage of ICT in economic development (including job creation, ICT services), human skills development and supporting enabling policy and regulatory frameworks. The main modes of technology transfer are through turnkey project foreign direct investment, purchase/sale of software and hardware components. Mugabe (2003:5) argues that to develop confidence and reduce costs, technology transfer and cooperation for success needs agreed upon modalities by both innovative institutions. These institutions can be knowledge centers, universities, private and public innovation hubs. Muthoni, Omato, and Kithinji (2013:171) find that access to technology or technology acquisition and its transfer to these institutions and small and medium enterprises is important for economic development. Pearce, Albritton, Grant, Steed, and Zelenika (2012:42) further state that the transfer mechanism for the information and communication technologies may not be adequate, resulting in poor technological diffusion for the recipients. Technology transfer has to address the needs of entities at both the national level and local or district level. Maya (2003:4) surmises that the recipient of the technology transfer must recognize the ability to utilize and manage imported ICTs, understand the important technology and customize it for local conditions. They must also have the capability to innovate the technology and scale it up for commercial usage in the market. According to Hung (2008:34), a strong infrastructure base and its development are important for technology transfer to be sustained. Using India as an illustration, Hung (2008:34) observes that to promote and sustain IT competitiveness, India has had to innovate

to improve its institutional performance and legal system, which included reducing bureaucracy whilst enforcing protection of copyrights.

Carlsson, Jacobsson, Holmen and Rickne (2002:234) declare that one of the most important relationships in innovation systems is associated with technology transfer. Some technology may be transferred unintentionally (known as spillover) or intentional for both supplier and receiver. The technology process usually involves a collaborative process of some duration and not a once-for-all transaction. In studying these technological processes, Carlsson et al (2002:237) state there are three types of networks that are involved, namely, buyer-supplier (input/output) relationships, problem solving networks, and informal networks. It is the problem-solving networks that define both the nature and boundary of the technological system. Carlsson et al (2002:237) find that the technological system is always evolving with changes in the content used in the technology and the products created as well as the linkages to other technologies. Carlsson et al (2002:243) outline performance measures for an emerging technological system, which are:

- Patent indicator – showing the number of patents and the impact technological process and system;
- Number of scientists and/or engineers active in the technological fields;
- Cross-fertilization of different technologies, which create new and difficult-to-foresee combinations of knowledge;
- Technological and technical diversity reflecting the robustness of the system and its potential growth.

Foxon, T. J., Gross, R., Chase, A., Howes, J., Arnall, A. and Anderson, D. (200l5:2125) point out there may be failures when the innovation system does not focus on ensuring the actors and their links work effectively, especially when the system does not remove blockages that hinder the effective networking of its components. In their study, Foxon et al. (2005:2125) found that innovative systems are nonlinear and dynamic, involving feedbacks between different stages of development. These different stages of development in technology transfer lead towards commercial maturity of the technology. They define the stages of commercial maturity as:

- Basic and applied R&D - demonstration of the technology;
- Pre-commercial – that is the first installation of the technology for commercial purposes at a limited scale;

- Supported commercial – which is the installation of the technology for commercial purposes with some support; and lastly,
- Commercial - where the technology is competing within the broad regulatory framework.

The availability and use of ICTs are a requirement for economic and social development (Fong: 2009:3708). Least developed countries have the possibility to develop their economies without the headaches and challenges encountered by the developed countries. Skipping over the mistakes made by the developed countries allows least developed countries to leapfrog in the uptake of ICT usage. This uptake requires skills, capacity to absorb new knowledge and innovativeness to apply the acquired technologies. Asheim and Coenen (2005:1179) advocates the innovation system is seen as an economic structure with an institutional set-up that affects knowledge absorption and learning. They observe innovation has always been the key to social and economic development as humans respond to various challenges confronting the human race from time to time. Carey (2004) observed that global innovation nations did not include an African country and very few patents have been registered by inventors in Africa. Never-the-less, innovation requires technical capabilities that leads to opportunities in the markets through various types of learning.

Foxon et al. (2005:2133) argue that the sharing of knowledge strongly influences the direction and success in developing enterprises. Innovation in ICT requires some R&D and least developed countries have insufficient R&D capital expenditure, which has an impact on the accumulative knowledge that is acquired for innovation (Hegde, 2008:2). On the one hand, the lack of R&D capital pushes the use of foreign innovation in science and technology. On the other hand, it sets the stage for knowledge transfer to occur, but not necessarily with the adequate upgrading of skills for a better human capital. According to Fong (2009:3708), transfer of immature or nascent technologies could pose a risk when undertaking knowledge transfer with technology leapfrogging, unless the following main factors are taken into consideration:

- Human capabilities – adequate investment in education and skills transfer;
- Government –from providing national education and also the use of incentives to encourage private-public partnership in the provision of training resources;
- Institutional capacity – have an enabling regulatory and legislative framework to allow innovations to grow, supported by the intellectual capital development;

- Stakeholders – have interaction with strategic partners for knowledge and technology transfer.

Irrgang (2007:2) postulates that technology transfer is influenced by the technical tradition currently understood by the recipient and also by ongoing innovations in both source and recipient environments. Within this process of technology transfer trajectory, the least developed economies, particularly those in Africa, face daunting challenges in literacy, educational attainment and absorption capacity. Among the key factors identified (e.g., Amadi-Echendu and Mulamula, (2010:6), Chourabi, Nam, Walker, Gil-Garcia, Melloul, Nahon, Pardo, and Schol (2012:291)) as being able to support or impede technology adoption economies that are emerging, the following are considered:

a) Governance and the availability of domestic financial resources – reducing dependence on donor funds as investments made with external financing, which tend to be limited and misdirected in usage;
b) Management and the degree of skills and training of the workforce – the ability of the human resource to have absorption capacity of the transferred technology;
c) Basic infrastructure – broadband networks, roads that allow firms and people to be connected both internally and externally;
d) Working enabling environment and conditions – a conducive entrepreneurial eco-system to allows startups and SMEs to grow;
e) People and cultural attitudes – the mindset to take risks to become entrepreneurial and create startups and SMEs.

Technology rarely stands independently - usually it depends on different complementary mechanisms and capabilities that have connection to other industrial sectors. For example, the capacity to produce ICT devices like circuit boards requires inputs from the fabricated metals and plastics to produce cases or enclosures. Technology can be effectively transferred to an environment with adequate absorptive capacity in terms of scientific, technological, institutional, and legal infrastructure and framework. With the ongoing globalization of economies, technology transfer is propelled by multinational corporations through foreign direct investment (FDI) and international trade. As much as trade promotes economic growth, Blalock. and Veloso (2005:14) argue that research has not discussed trade as a mechanism for technology transfer. The UN Economic and Social Council report (2001:3) surmises that technology transfer meant to provide lacking technical knowledge in emerging economies in a particular economic or trade environment can occur through direct or indirect mechanisms.

Direct mechanisms can be the buying of capital goods and equipment, the training of recipients' in specific technologies, and the use of foreign experts and consultants. Indirect mechanisms may include specific turnkey service provision and joint venture partnerships between sources and recipients. Technology Transfer (TT) is one of the key "means of implementation" processes and the technology transferred can function as a positive measure to achieve sustainable development United Nations Commission for Sustainable Development (2002:61).

2.3 A discourse on sustainability and the 2015 sustainable development goals

Sustainable development is a multi-dimensional concept with environmental, social and economic considerations. The most cited definition of Sustainable Development is the "Brundtland definition" as, '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*'. (Hilty, Lohmann, and Huang , (2011:13)). Sustainable development is "*the challenge of meeting growing human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future life and development*" (International Institute for Sustainable Development, 2014:66). Tan (2009:7) observes that sustainable development is a notion that is part of human civilization in a natural world and is necessary for survival of human kind. Brito (2005:44) states that for Africa to wean off its dependency on the developed nations, she must have a sustainable strong knowledge sector of its own.

In September 2015, a UN summit with the development agenda of Sustainable Development Goals (SDGs) to replace the Millennium Development Goals (MDGs) took place. The SDGs have 17 goals, namely: Goal 1: no poverty; Goal 3: good health and well-being; Goal 4: quality education; Goal 5: gender equality; Goal 6: clean water and sanitation; Goal 7: affordable and clean energy; Goal 8: decent work and economic growth; Goal 9: industry, innovation and infrastructure; Goal 10: reduced inequality; Goal 11: sustainable cities and communities; Goal 12: responsible consumption and production; Goal 13: climate action; goal 14: life below water; Goal 15: life on land; Goal 16: peace and justice strong institutions; and, Goal 17: partnerships to achieve the goals.

The SDGs guide development in the world until 2030. In realizing the SDGs, it is argued that ICTs are key enablers of development (Earth Institute, 2015:12). Information and communication technologies provide one of the underpinning platforms for economic growth of countries. The broad application and deployment of information and communication technology (ICT) based services and systems offer the possibility for the needed deep transformation in the LDC economies. Though each LDC may emphasize its own set of sustainable development targets based on its stage of development there is widespread recognition that ICTs permeate all disciplines of human endeavor irrespective of political, economic, and social contexts. The effective use of ICTs, and the manner in which the inherent technology transfer with capacity building is implemented, has an impact on how the user can absorb this technology for sustainable development.

The sustainable development process has an important pillar of human well-being that supports capacity building (Holdren, 2008:424). The process involves issues of production, employment, income, wealth, markets, trade, and technologies. The process assumes an awareness of the environmental challenges and socio-economic matters that relate to poverty and inequality. It is concerned about the future well-being of humanity. Holdren (2008:424) provides the following definitions of development and sustainable development:

- Development means enhancing the economic, environmental and sociopolitical aspects of human condition;
- Sustainable development means the consistent maintenance, economic growth and social progress of humanity indefinitely, with protection of environment and careful use of natural resources.

The Nobel prize awarded to Robert Solow for his theory of economic growth showed that it was not capital but technology which was the crucial ingredient in the growth of economies (Solow (in Garfield (1988:124)). This leads to the widely acknowledged view that knowledge and know-how of science, engineering, and technology (SET) are crucial to economic development. Fischer (2005) argues there is evidence that points to the mirror relationship between the growth rate of the global economy and the rate of technological development. He concludes the differences in levels of SET and innovation correspondingly manifest as differences in total productivity between countries. The UN Commission for Sustainable

Development (2002:9) points out that where national systems of innovation[3] are being implemented, they are not always aligned to local economic needs. They lack integrated and sustainable approaches to the provision of education and skills capacity building, and do not contribute to sustainable development. Developing economies, particularly those in Africa, face daunting challenges in literacy, educational attainment and absorption capacity, and such challenges are amplified by the need to effectively manage the technology transfer from source economies. In a study by Musa, Mbarika and Meso (2005:112), 75% of the world's population reside in developing countries but their share in terms of production is about 16% of the world's products, and this increases the challenges with respect to absorption and adoption of new technologies. The study also indicates that 40% of the population in Sub-Sahara Africa is functionally illiterate such that the impact, coupled with deteriorating educational systems, high employment rates and lack of electricity further compound the infrastructure necessary for technology transfer. Foxon, Gross, Chase, Howes, Arnall and Anderson (2005:2126) postulate that innovation systems need to be dynamic in the realm of globalization.

The effects of globalization amplify the already immense policy challenges that confront LDC's particularly with respect to the deployment of ICT's towards sustainable development. This is amplified by the Earth Institute (2015:11) report, which recommends governments to convey the vision of a networked society, to allow all parts of the society to be part of the ICT services and to facilitate the rapid diffusion and uptake of ICT systems. The same report suggests governments to take the lead in ensuring that the population is ICT ready through age-appropriate STEM (science, technology, engineering, and mathematics) education at all levels of schooling. The (Earth Institute, 2015:11) report also observes that ICT enterprises that are incubated using new business models and working in cooperation with government, can get training at all levels. This includes the technical workers needed to write the software programmes and mobile apps and to manage the infrastructure of the new ICT systems. Training in entrepreneurship through incubators can also help to spur new business development. Local ICT companies are vital for providing local solutions and applications with a local context and international ICT companies operating locally help facilitate the rapid diffusion of ICT-based solutions (Earth Institute, 2015:11). For example, the speed of diffusion of mobile broadband reflects certain critical characteristics of ICT

[3] Wikepedia describes the national system of innovation as teh flow of technology and information among people and instititions/firms that is important to the innovation process at the national level.

technologies, including: their rapidly declining costs; business models that enable access of poor households to the technologies; remarkable larger range of low-cost or free applications; and, the ability to build wireless broadband to reach the 'last mile' through microwave transmission rather than physical cable. Gerster and Zimmerman, (2003:7) maintain there are three different approaches for ICT sustainable development that can be acknowledged in ICTs:

- Technical production and supply;
- Information content created by firms, organizations; and
- The recipient utilizing the content.

ICTs can significantly improve the speed in which SDG-related technologies are understood and implemented. Cognizant that the human society involves a growing population, Pearce et al (2012:42) surmise that there is a challenge in how the needs of an expanding population are met in a reasonable and impartial way. Pearce et al (2012:42) consider two important issues in sustainability effects of new technology developments and SET innovations:

a) Every technology has a sustainable potential that can be identified and this requires additional knowledge in order to enable decision makers to assess the validity of the potentials; and,

b) Besides the positive potentials of new technologies for sustainable development, there might also be negative effects, which should also be taken into account to provide a comprehensive and balanced picture of the potential.

Pearce et al (2012:42) argue that an adaptive approach to having sustainable development supported by new technology developments is required. Monitoring and evaluation is needed that enhances a feedback mechanism that integrates lessons learned and new knowledge into the overall innovation system.

2.4 A discourse on capacity building, especially 'human capital index'

The capacities and skills that are found in people and those that can productively be used in a country, form a nation's human capital endowment. This is one of the resources that determines the long term economic success of a nation according to the World Economic Forum (2015:3) report. This report argues that human capital is part of the knowledge base that is important for the functioning of all sectors of the nation including social, civic and political institutions. Capacity building is a process that enhances existing technical and

scientific skills, capabilities of people and institutions while developing, building and strengthening their capacities. Done properly, it enables least developed countries to analyze and customize acquired appropriate technologies that fit the local environment.

Virji, Padgham and Seipt (2012:117) write that for capacity building to be effective and sustainable, efforts to build capacity should go beyond the class-room based training to catalyzing knowledge that is action based. It must be driven by a developing country's priorities that embrace the strategies and initiatives that include the nation's organizational and resource capabilities for sustainable development. Adam and Urquhart (2008:4) define IT capacity building as *"…the process of creating or enhancing local human and organizational abilities to use IT to perform specific tasks in organizations in order to attain organizational objectives.*" Adam and Urquhart (2008:4) find that three circumstances are necessary for successful capacity building, namely:

(1) An ecosystem that has the appropriate policy and legal structure supported by methods and tools that enable the process of capacity building;

(2) Acknowledgement that community development efforts are crucial and supports their inclusion in the capacity building process; and

(3) Appropriate training and development being part of the human resources development.

The human capital index (HCI) seeks to serve as a tool for capturing the complexity of education and workforce dynamics so that various stakeholders are able to take better-informed decisions (World Economic Forum, 2015:16). Table 2 shows the human capital index rakings for LDCs in sub-Sahara Africa.

Table 2: Human Capital Index 2015 rankings of LDCs in Sub-Sahara Africa

Sub–Saharan Africa		
Rank	Country	Score
83	Zambia	62.50
102	Uganda	57.34
103	Tanzania	56.56
104	Madagascar	56.25
107	Lesotho	54.74
108	Rwanda	54.17
109	Mozambique	54.04
110	Malawi	53.49
111	Senegal	53.04
115	Ethiopia	50.25

116	Burkina Faso	49.22
118	Mali	48.51
119	Guinea	48.25
121	Burundi	46.76
123	Chad	41.10

Source: The Human Capital Report 2015

The Sub-Saharan Africa region, with an overall average score of 52.41, ranks lowest compared to other regions. Based on business executives' perceptions in the ease of finding skilled employees, the top LDC performers in the region are Zambia (ranked 83) followed by Uganda (ranked 102) and Tanzania (ranked 103) while Rwanda (ranked 108) is sixth. Burundi (ranked 121) and Chad (ranked 123) are the lowest performers in the region. Finland is ranked number 1 with a score of 85.78.

Urquhart, Liyanage and Kah (2008:204) observe that ICTs catalyze the building of human and social capital by building endogenous knowledge and human capacity for wealth creation. According to Unger, Rauch, Frese, and Rosenbusch, (2011:343) human capital is defined as, *"skills and knowledge that individuals acquire through investments in schooling, on-the-job training, and other types of experience."* De Carolis and Saparito (2006:43) identify social capital as the private-goods model that focuses on person and their network relationship. Whereas human capital is associated with individuals, social capital is associated with relationships. Human and social capital can be attributed to investments and national systems of innovation UN Commission for Sustainable Development (2002:9). Adam and Urquhart (2008:4) claim that most literature on ICT capacity building give attention to the issue of human resource capacity that is weak in least developed countries at a national level and not at an industrial or organizational level. At an individual level, Adam and Urquhart (2008:4) find that literacy is a requirement for the usage of computers (includes technology tools) and most times the language interfaces are not in the user's local language. For example, lack of understanding the English language by the recipient is a barrier when English is not the common language of communication. Peansupap and Walker (2005:195) state that some of the overriding factors that contribute to the unsuccessful adoption and implementation of information technology are technological characteristics, individual characteristics and the nature of knowledge sharing. Also in developing countries the lack of human capital makes it difficult for technology absorption capability to occur (Lee, 2001:128).

Warschauer (2003:300) warns that there is a difference between computer mediated communications literacy, general computer literacy, multimedia literacy and information literacy. Understanding these differences may be useful when considering the different kinds of training that may be required in capacity building. Hung (2008:38) states that an improper education system and training methods restrict the nurturing of students' innovative capabilities and this impedes appropriate capacity building in the system. In his study of the Chinese education system, Hu (2000:533) advocates the fostering of innovation by focusing on basic education and acquiring appropriate knowledge as this is important for capacity building Capacity building is much more than training, according to Davidson and Zeng (2003:20). It involves the following:

- Human resource development – putting in place a methodology that allows information access and equips people with the knowledge and skills that enables them to execute their functions effectively;
- Organizational development – having effective organizational and management structures, which follows understood processes and procedures, supported by appositely managed relationships with other firms and sectors, both public and private; and,
- Institutional and legal framework development – the policies, strategies and initiatives that allow all types of firms and institutions to increase their capacities.

Capacity building also requires higher learning institutions (HLIs) having a curricula that enhances the triple helix relation between technology transfer, capacity building and sustainable development. This alludes to a link between HLIs, industry and government in developing strategies that build capacity. The network system of university-industry-government relations helps development actors translate policies into actions. A triple helix development model is based on the following trends (Dzisah and Etzkowitz, 2008:107):

- The transition from an industrial society to a knowledge-based society in which knowledge producing HLIs play an important role in innovation and development;
- The emergence of different forms of technical knowledge, which is both theoretical and practical, that is publishable and able to lead to product development and commercialized;

The rise of new HLI formats require that they incorporate a disciplined technology development process with a culture of entrepreneurship, innovation and technology transfer. This means a

curricula that increases the supply of graduates who are trained to fill the skills gap desired by industry. In a discussion paper, Juma (2016:15) states for economic transformation to occur the educational systems need to have the following criteria as a minimum:

- curricula needs to address the local requirements
- innovative HLIs need to have clear visions and plans that scale-up research results into the market-place
- HLIs form partnerships with industrial stakeholders so that student's ideas can be translated to realistic products and services impacting the local communities with the assistance of these stakeholders

To build capacity that sustains the capability of HLIs in ICT, there has to be some reliance on local initiatives involving people-to-people interaction to enhance the value of alliances and partnerships among technology transfer entities, government, civil society and the private sector. Partnerships for capacity building and skills development can increase both the quantum of available resources for education and the effectiveness of policies on sustainable development. It is remarkable that technological know-how may be concentrated in developed economies, thus exposing developing economies to dependence and subjective monopolies, which often impose inappropriate technological solutions to unique developmental problems.

2.5 A general discourse on LDC SME development

Bourdeau-Le Page and Kolarova (2005:16) suggest that evolution into a knowledge-based economy, which utilizes science and technology (S&T) based production, demands increasing stocks of human and socio-political capacity. This is for a science and technology-based production sector utilizing small and medium enterprises. Exploitation of suitable technologies by the SME community in a least developed economy depends to a great part on the capacity of human and institutional structures. Conti (2002:35) posits that it is required to support and adapt to the complexities inherent in technological innovations. In the least developed world, there is a revived interest in SMEs to be innovative and use S&T in the face of globalization. LDCs and also developed countries recognize the important role the SMEs play in creating employment, enhancing growth and bringing about social cohesion, mainly through innovation and entrepreneurship. Furthermore, SMEs adapt easily to market conditions, have lower capital costs associated to job creation (Kongolo 2010:2290). With

changes in the way business is conducted in the global economy, least developed countries are compelled to define again the function of SMEs in their national economies, so as to get the greatest possible positive growth from their engagement. LDCs are striving to make their nations be knowledge driven so as to enhance creativity, innovation and entrepreneurship. According to Ajayi (in Ogunsola (2005:2)), the revolution taking place in information and communication technologies is the foundation and main driver for the globalization process. SMEs need to take advantage of opportunities these technologies are creating, especially through incubation systems. Never-the-less, SMEs face several common problems: lack of capability to scale up acquired technologies, inadequate capacity to market their goods, not able to get institutional credit, nonexistence of innovation in the production process and diversification produced goods, and inadequacies in ICT infrastructure (Chandra 2008:19). Technology transfer/diffusion to SMEs has to be designed in such a way that it is acceptable to both the source and the recipient environment.

MacVaugh and Schiavone (2010:206) list three main types of users for any system of technology innovation diffusion, namely, the individual user, the community user and the innovation industry or SME. In LDCs, SMEs have difficulties of technology diffusion involving information management, financing and training for capacity absorption. This leads to questions of appropriate knowledge skills relating to policies and the framework involving structure, attitude and relationships linking the policies for best/good practices.

The creation of a 'learning environment' among SMEs for technology transfer/diffusion catalyses a continual process of integrating local craft with international standards (McNamara, 2005:5). SMEs need a well articulated organizational learning strategy that allows for a participative style of shared learning. In their analysis, Conti (2002:33) also observes that a good customized system that fits the local needs, links the knowledge that is transferred and expertise to the local manufacturing process. For SMEs' to have absorptive capacity, they need support in developing their managerial, organizational, and technical skills write Saad, Cicil and Greenwood (2002:625). Eriksson and Chetty (2003:690) contend that the concept of absorptive capacity can be used in describing SME innovation, in that it describes a SME's ability to use its prior related knowledge and varied background to recognize the value of new information and to be innovative. However, they point out that knowledge of specific relationships in a network is hard to transfer as it is learned by doing, and the more experience the entrepreneurial SME has of acquiring foreign market knowledge in previous agreements and tasks, the more absorptive capacity the SME will gain.

It is widely acknowledged entrepreneurship that fosters SMEs is indispensable for economic development. Anokhin, Grichnik and Hisrich (2008:118) claim entrepreneurship is the main vehicle of economic development. Dejardin (2000:2) states, the more entrepreneurs there are in an economy, the quicker the economy will grow. Pade, Mallinson and Sewry (2006:101) point out ICTs embedded in entrepreneurial activities, markets, education, knowledge and health systems can promote sustainable rural livelihoods. Ericksson and Chetty (2003:678) contend that an entrepreneurial SME working in different markets can accumulate a varying range of knowledge, which provides the entity with the capacity to identify new opportunities to exploit. Zahra, Ireland and Hitt (2000:930) write, *"…the firm has to know how to integrate its knowledge by recognizing what it has learnt in the diverse markets and how it can use this knowledge in an ongoing business."* These new ideas and practices enhance the entrepreneur's and SMEs' capability to be innovative. Adam and Urquhart (2008:12) caution that a possible disadvantage of knowledge got through this channel may be that the information is often repetitive and old and thus may not add to the overall knowledge of the organization. Having an innovation system in place helps small and medium enterprises perform in an enabling environment that supports the usage of knowledge and the search for innovative solutions.

In the search for innovative solutions, there is the notion of reverse innovation or "trickle-up innovation". Brem and Ivens (2013:35) describe "reverse innovation" as a bottom up approach where technology transfer occurs through reverse engineering of innovated products from developed countries to LDCs or emerging markets. In other words, instead of the traditional approach found in the industrialized countries of research to distribution, technology in the LDCs and emerging economies moves in the opposite direction, from distribution to production to development to research. This means reverse innovation is a process whereby items are developed in a low cost production model in LDCs or emerging market economies to meet the needs of the industrialized world. Reverse innovation should allow the local creation of new products, testing and commercialization in the local environment. A successful outcome enables the product to be scaled-up and marketed in the developed countries. The products are then refined in the developed markets and sent back to the LDCS/emerging mrkets.

Considering that SMEs are seen to be crucial for national economic growth in LDCs, they could benefit from reverse innovation, supported by an incubation process. Incubators assist to lower the cost of business and increasing the chances of business survival. They provide a range of services, which include: (a) access to shared resources and building infrastructure; (b) facilitating access to finance; (c) provision of business development services, including guidance and business/finance management; (d) targeted mentoring and coaching; and (e) training; (f) fiduciary services; and (g) networking for technical trends and opportunities to access markets. Scaramuzzi (2002:4) defines incubation by referencing the National Business Incubators Association, who state, *"...incubation catalyzes the process of starting and growing companies, providing entrepreneurs with the expertise, networks and tools they need to make their ventures successful. Incubation programs diversify economies, commercialize technologies, create jobs and build wealth*." There are various models of incubators and they are differentiated by: (a) their mission (for profit or not for profit); (b) the support they get (public funding or private funding or mixed funding); and (c) their concentration (mixed use or niche in a specific sector). Regardless of the variation in types of incubators the following are the key incubation models, according to Scaramuzzi (2002:4):

- First generation incubators: the creation of science parks, technology parks with great public investment. Their vision is innovation, job creation and economic growth;
- University incubators: found on university grounds and they promote development of new research of their departments (including department collaborating entities). The objective is to commercialize new technology by linking research technology, funding and know-how;
- Virtual incubators: considered as "second generation" incubators, they have no walls in that they service SMEs and entrepreneurs/innovators in remote regions or areas with not enough critical mass of users;
- International business incubators: considered as "third generation" incubators are export oriented and provide a complete range of services that orient SMES towards linking them to universities, R&D institutions, international joint ventures and venture capital,
- Incubator networks: these are different incubators that collaborate to share their knowledge and resources; and,
- Dot.com incubators: considered "fourth generation" incubators and sometimes are internet business accelerators. They have strong venture capital tendencies with incubation periods which are a few months.

2.6 Analysis of Literature

Empirical studies, though based on implicit assumptions, conclude there is economic value of ICT diffusion Fong (2009:3708). In the quest to learn technical skills and apply fast changing technologies, the outcomes and changes made possible are not clearly understood. Many least developed countries in Africa are beginning to put in place ICT transfer strategies that support their economic development. Many authors (Sarif and Ismail (2006:135); UN Economic and Social Council (2001:17)), imply that technology transfer is meant to provide the technical knowledge lacking in a particular economic environment. Unfortunately, this technological knowledge is concentrated in firms found in developed countries (Hoekman, Maskus and Saggi, 2005:1597). This is further complicated by the receiving nations generally not having a good baseline data for the transferred knowledge to build upon. This exposes many least developed countries to technological dependence and there is the observation by Tan (2009:7) who contends it is difficult for LDCs to regulate technology transfer. ICT transfer and knowledge uptake in least developed countries, is about adapting existing products and processes to achieve higher levels of productivity as applicable to their local context. Tambunnan (2007:5) posits information and communication technologies as enablers of development, and articulate the following as factors that may influence the transfer of ICT between source and recipient economies:

a) Equal access to market and market information;
b) Income generation through expanded economic networks and increased productivity;
c) Wider employment opportunities;
d) Empowered governments – more efficient, transparent and accessible government processes and services;

Nissanke and Thorbecke (2010:7) argue that because labour that is educated and skilled is favoured in a nation, the usage of new technological innovations tends to increase the inequalities in both developed and developing countries. The implication is that tacit knowledge, which forms part of the absorption capacity, provides the impetus for technology transfer in this era of the knowledge-based economy. In other words, making the transition to the "new" economy that is driven by technology and information requires a workforce that can respond to new challenges and pursue life-long learning opportunities (Kefala 2010:165). Adam and Urquhart (2008:4) write LDCs are seen to have weak human capital. Effective technology transfer requires the recipient country to have the requisite levels of skills and

knowledge corresponding to the scale of technology. This would facilitate effective communication and interaction with the transferring agents. Such a consideration entails both intensive and extensive technical training, management development and education programs. The ICT related to education in both private and public sectors, is expanding rapidly, but businesses find there still is a lack of qualified technical skills, according to James, Kartano and Miller (2004:4). Misuraca (2009:84) acknowledges the use of ICTs offers great possibilities for raising the standard of living, including impacting on governance, infrastructure, basic literacy and building absorption capacity.

It can be argued that the exploitation of suitable technologies in the developing economy, depends to a large extent on the capacity of human and institutional structures to support and adapt to the complexities inherent in technological innovations (Hu 2000:533). . Maya, (2003:4), Davidson and Zeng (2003:20), speculate that the transfer of technology depends on the level of the existing stock of knowledge, absorptive capacity of the recipient entity, as well as the policy, legal and institutional frameworks of both the source and recipient economies. To support this, Conti (2002:35) contends that institutional structures are important in the recipient entity to be able to have absorptive capacity. However, Pearce, Albritton, Grant, Steed and Zelenika (2012:42) caution that information and communication systems are not very effective in spreading technologies among the wide range of recipients, especially where there are no appropriate policies to support the transfer. The achievement of ICT implementations in a nation is closely linked to the national ICT governmental policy as postulated by Camara (2007:3). According to Gilhooly (2005), ICTs that are identified for development policies and programs, need to be embedded within the overall development process. This helps to achieve the right balance between investment promotion and meeting the needs of users of the services. It catalyzes and enhances profitable business models that bring about the growth of SMEs in the local delivery of affordable ICTs to rural and urban areas. The literature review enforces the primary proposition of this study that ICTs influence all forms of human endeavor. By extension, ICTs become tools and enablers for capacity building of SMEs' for sustainable development.

Chapter 3 Case Studies of Countries with recent histories on ICT-enabled development

3.1 ICT Sector Overview in Africa

Africa lags the rest of the world in adoption of new technologies, ICT investment and penetration as shown in Figure 7. The gap is more pronounced in the case of broadband internet related services, and fixed telephony, which are part of the conduits that allow knowledge and technology transfer .

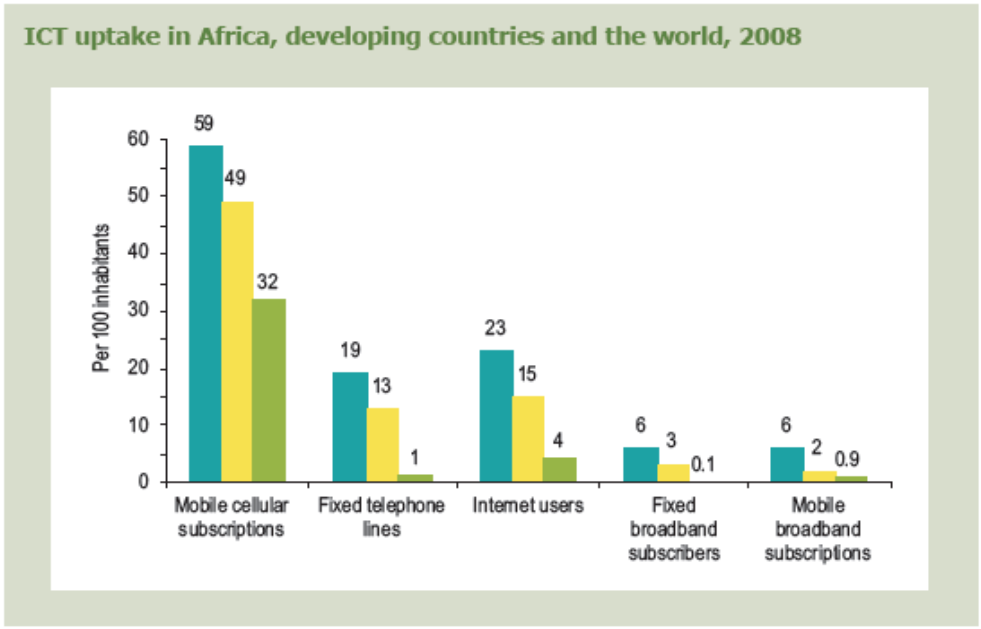


Figure 7: Comparison of ICT uptake in Africa, Developing Countries and the World
Source: ITU World Telecommunication/ICT Indicators database.

3.1.1 Access to Broadband in Africa

The continent has seen a dramatic growth in voice communications segment in the last few years driven by wireless technologies, based on a study conducted by Mulamula, Butare, Adam and Okello (2013:14). According to a report to ITU by Global System for Mobile Association (GSMA 2011:9), the number of mobile connections grew from 28.3 Million subscribers in 2007 to 620 Million in 2011, a growth of 22%, as depicted in data in Table 3. Over a half of the population in the region has access to SIM cards, although the actual

penetration of mobile phones is measured to be lower due to ownership of multiple SIM cards. Over a third of the African population has access to mobile phones.

Table 3: ICT Sector Development in Africa

	(millions)					**Per 100 inhabitants (%)**				
Year	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
Mobile subscribers	174	246	295	553	645	23.3	32.1	37.5	57	65
Fixed Line subscribers	11	11	12	12	12	1.5	1.4	1.5	1.5	1.4
Internet Users	27	45	69	90	139	3.6	5.9	8.8	9.2	13.5
Mobile Broadband Subscribers	2	8	17	27	30.3	0.3	1.0	2.2	3.2	3.8
Fixed Broadband Subscribers	1	1	1	1.1	1.1	0.1	0.1	0.1	0.15	0.15

Source: International Telecommunications Union, http://www.itu.int/ITU - D/ict/statistics/index.html

The mobile revolution opened up opportunities of enhanced communication that allowed accrual of benefits to institutions, households, SMEs and the rural poor. The generation of many mobile applications with quality have increased over time. . Mobile money transfer is one of the most popular services that have extended access to banking services to those in rural areas. Mobile services have also enhanced the delivery of services from government to citizens, government to businesses and businesses to citizens, in areas like health, commerce, education, to name a few, all this communication reaching the “bottom of the pyramid” in a nation of people who were not connected prior to the mobile revolution.

The Africa Mobile Observatory report (GSMA 2011:14) also estimates that the number of mobile broadband connections were 15 Million in 2010 and expected to be 250 Million in 2015.

Nevertheless, the growth rate in the mobile sector has not been replicated in the internet sector. From 2007 to 2011, internet penetration has grown twofold, but 87% of the African population is still unable to connect to it according to the same statistics. The limiting factors to connecting onto the internet include illiteracy, non-affordable mobile and computing devices, not enough and non-affordable bandwidth. The limited number of fixed telephone lines constrains the deployment of broadband access.

Africa's fixed broadband penetration has been declining over the last decade with growing population and aging fixed lines. As shown in Figure 8, fixed line is just 0.2% in 2011, a figure very much behind the 26% penetration that was achieved in Europe.

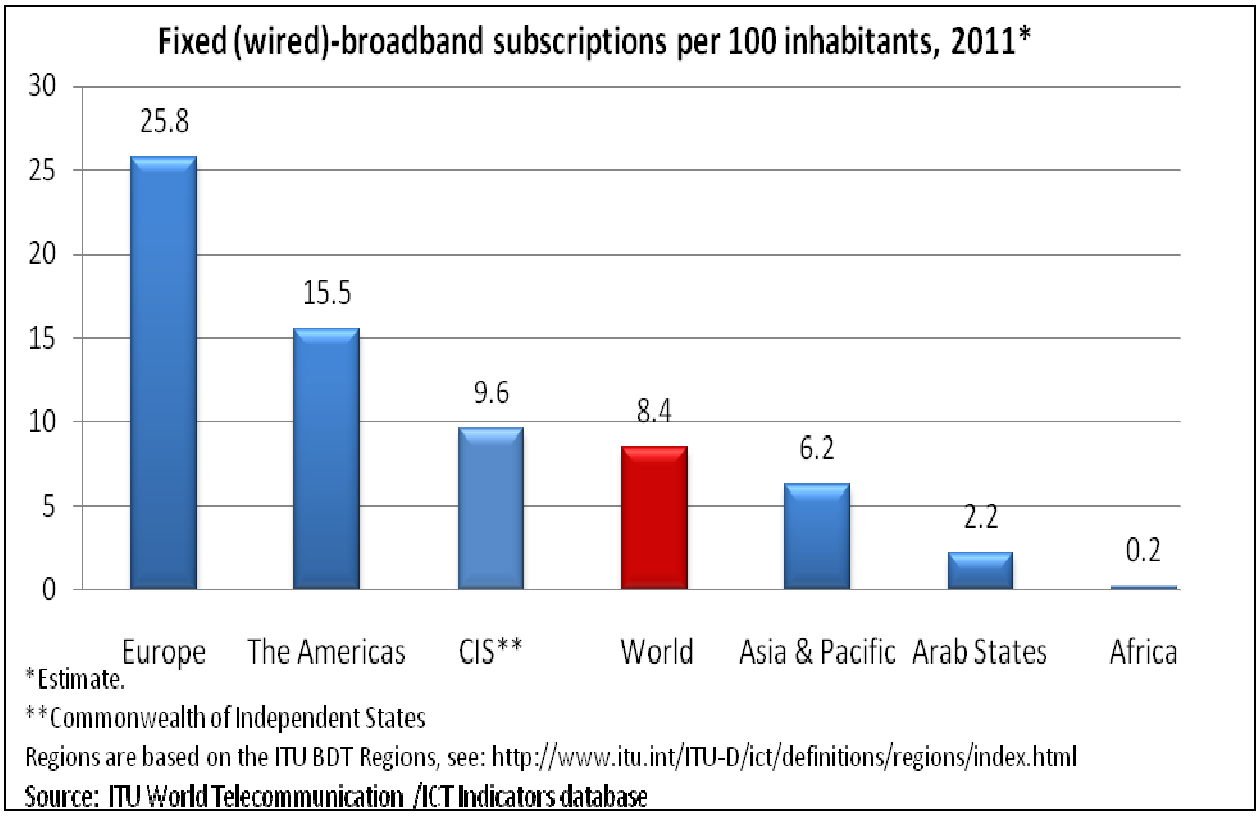


Figure 8: Global Fixed (Wired) Broadband Subscription per 100 Inhabitants
Source: http://www.itu.int/ITU-D/ict/definitions/regions/index.html

Analysis shows that third-generation (3G) mobile networks and lately fourth-generation (4G) networks are on the rise in Africa, compared to fixed broadband networks.

Still, the broadband mobile penetration which is expected to grow faster was about 3.8% in 2011 still far behind the 54% that was achieved in Europe as seen in Figure 9.

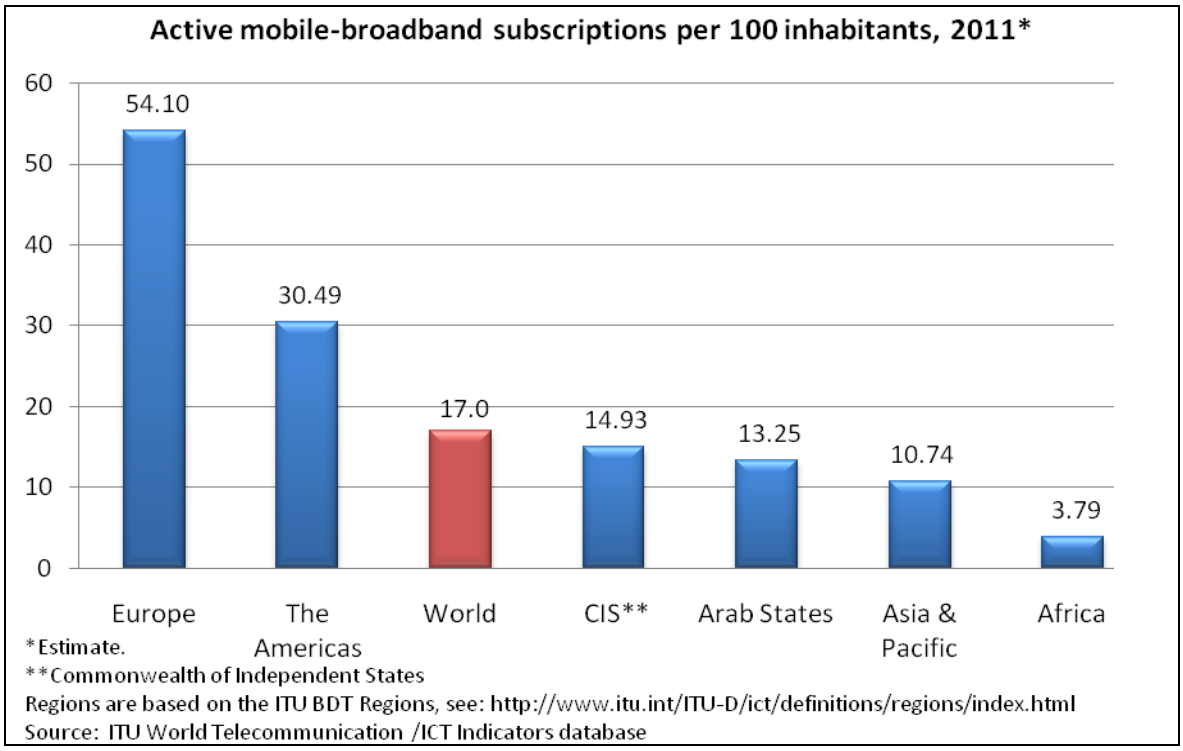


Figure 9: Active Mobile Broadband Subscriptions per 100 Inhabitants
Source: http://www.itu.int/ITU-D/ict/definitions/regions/index.html

Africa has seen a spectacular growth of international bandwidth in the last few years. Northern Africa is served by a variety of cables including Atlas Offshore, SAS-1, SEA-ME-WE 4, EIG and I-ME-WE with a total bandwidth of well over 10 terabytes. The completion of undersea cables such as WASC, ACE and SAFE is expected to increase the current bandwidth in the western coast of Africa from around 4 terabytes to 40 Tbps along the west coast of Africa and 60 Tbps along the east coast of Africa by June 2016 (AfterFibre 2016). The proposed undersea cable by the Brazil, Russia, India, China and South Africa (the BRICS countries) to each other and the US is also expected to increase the international bandwidth by many folds. The Eastern Coast of Africa that has seen a completion of a number of cables including EASSy, SEACOM, LION and TEAMS has also seen a dramatic increase of international bandwidth to about 7 terabyte. The study done by Mulamula et al (2013:31) also found that there is still a wider gap in terms of bringing access to the latest multimedia capable broadband technologies to rural and underserved areas. The ability to

access health information, educational resources and to watch video streaming, use voice over internet (VOIP) applications, and transfer work files and audio-visual files with some ease is becoming essential for farmers, households, schools and enterprises alike. This data/information forms part of the process of knowledge transfer especially in the marginalised areas. It requires considerable innovation in terms of technology, business models and partnership between players to ensure that broadband access is affordable in rural and underserved areas.

3.1.2 Policy and regulatory development in Africa

The overall awareness of the roles of information and communication technologies for national development over the last decade has generated a number of national ICT policy papers. Key players such as the World Bank (WB) and the International Telecommunication Union (ITU) have been investing in policy and regulatory capacity building in Africa. The World Bank and ITU have collaborated in the development of ICT regulatory toolkits that have created an overall awareness of key technical and economic regulatory issues. In Africa, policies and regulations in the technology sector have been promoted within four fronts: Regional policies and strategies; Regional regulatory harmonization efforts; National ICT policies and strategies; and Technology regulatory frameworks. Furthermore, the establishment of a continental harmonized policy and regulatory framework that attracts investment and fosters affordable access to broadband was one of the key components of African Union (AU) Commission's ICT strategy for 2010-2015. The African Union envisages this can be achieved through: Liberalization of the ICT market and promoting competition; Continental, regional and national infrastructure development; Development of access to technology through knowledge/technology transfer at national level; and Reduction of access tariffs

However, the implementation of these national policies and strategies vary from one country to the other. Most developing countries have difficulty to implement the policies due to limited commitment and inadequate appreciation of the ICT ecosystem. In particular the countries do not understand the complex interaction between policy and regulation, access, knowledge and technology transfer, skills and technological innovations. Some countries have sectoral ICT policies derived from national policies like the national ICT policy or national science, technology and innovation (STI) policy. These provide more detailed

planning and resource allocation and allow for the implementation of the ICT policies in a strategic manner, provided the requisite skills are available. These sectoral ICT policies have been crucial in:

- Providing clear political direction in the use of ICTs in the respective sectors;
- Setting priorities for the sector with regard to needs, goals, levels, resources, timelines;
- Providing a basis for better informed and improved decision making, and therefore a more strategic approach to a complex issue of integrating ICTs in various areas like promoting education, health, agriculture, to name a few sectors;
- Providing a coherent framework for ICT interventions, including knowledge and technology transfer;
- Mapping out how and where ICTs fit in the economic system and how they can be optimally utilised to address institutional needs and meet institutional requirements;
- Highlighting the benefits and challenges of ICTs and how to engage and deal with them in a systematic manner; and
- Preventing disjointed, uncoordinated, fragmented and wasteful purchase, deployment and use of ICTs for development.

While the main trend in most of Africa has been to establish a sector-specific regulator, some countries have moved a step further towards expanding the mandate of the regulator to include one or more of other sectors such as posts, information technology, broadcasting content, and spectrum management. Converged regulators have been set up in Tanzania, South Africa, Kenya, Uganda and Mauritius to regulate the telecommunications, broadcasting, and information technology sectors. Increasing convergence also means that there is a need for a shift to open more market segments to competition and update licensing and spectrum management practices in order to foster growth in broadband networks and converged services. The protection of intellectual property rights, transparency of regulation, and protection of privacy and personal data is becoming increasingly important. This implies that the regulatory environment should be innovative to take on the wider ICT ecosystem and cope with contentious markets and the uptake of appropriate technology and knowledge transfer.

3.1.3 Skills development in Africa

Human capacity development is one of the main constraints to the spread and use of appropriate technology across Africa. ICT illiteracy not only hinders economic and social development – it is also a major obstacle to competitiveness of the continent in the global economy. The skills that prepare the population for a knowledge economy are required at all levels. At a lower level, ICT education in schools and colleges is important to prepare students for the knowledge economy and facilitate the learning process. Professional training in ICTs and minimum understanding of basic computer applications is a key for day-to-day functions of civil servants. There is a skills gap is evident especially in managing large scale e-government project (Mulamula et al, 2013:58). The report by Mulamula et al (2013:57) suggests that African countries require a critical mass of ICT experts that design, manage and implement e-applications projects and participate in the global IT Enabled services. Advanced software engineering and network management techniques are key for competitiveness and to managing large scale public sector ICT programmes. The countries of East Africa, for example, have established ICT related academic institutions that provide degree programs in computing (computer engineering, computer science, information systems, information technology, and software engineering) and networking.

The International Telecommunication Union (2009:43) states that, compared to other regions in the world in the past few years, , Africa has seen a high growth in ICT developments with an increase in mobile phone subscribers and internet users. It also suggests that the digital divide between the African continent and the rest of the world is much greater than the divide among the countries within the African region. Furthermore, there are challenges facing the public and private sectors arising from the implementation of information and communication technologies (ITU 2010:11). ICTs can be a tool and/or an enabler that affects all sectors of the economy, including the environment, cyber crime and security, education, innovation, business, health and banking. Policymakers and regulators must understand the wider ICT ecosystem to guide the sector (ITU, 2010:11).

3.1.4 Technology incubation hubs

The eTransform Africa report documents the growth of technology hubs across Africa - such as iHub and NaiLab in Kenya, Hive CoLab and AppLab in Uganda, Activspaces in

Cameroon, BantaLabs in Senegal, Kinu in Tanzania or *info*Dev's mLabs in Kenya and South Africa (Yonazi, Kelly and Halewood, 2012:6). Hubs like these are creating new areas for the development of local content applications with innovation. Some offer training and collaboration that supports incubation of SMEs. In this eTransform Africa report, the experiences highlighted offer many useful lessons for African policy makers wanting to make maximum use of ICT for transformation and scaling-up of good practices in ICT implementation. For example:

- The local environment and ecosystem must be considered when developing and deploying ICT applications.
- New innovations and technologies are propelled when governments initially utilize them and at the same time showcasing their role in creating an enabling environment for such applications to be scaled-up.
- The principals of open data and innovation form the basis of successful use of ICTs by different economic sectors and stakeholders.

3.2 Case study of two East African LDCs: Rwanda and Tanzania

Literature review indicates that the use of ICT for leapfrogging development and initiatives to build absorptive capacity by LDCs are a specific strategy for economic development. In this study, two least developed countries looked at are Rwanda and Tanzania, whose leadership believe ICT will help Rwanda attain its Vision 2020 and likewise for Vision 2025 in Tanzania. Firms like Google, Microsoft, CISCO, Intel, to name a few, and a number of NGOs and private companies who use ICT services like Voxiva, Technobrain are requesting to supply their services to the two countries. In the supply of these services, the external firms/entities do not usually provide enough knowledge to allow the recipients to be innovative enough to re-engineer the technology for the Rwandese and Tanzanian environment. As a consequence for example, computer systems with the English language get sent to rural areas where the population tends to speak in the native language of *Kinyarwanda or Kiswahili*. The usefulness of the services by the recipients then becomes limited by the ability to understand the means of communication. In some cases, computers have been delivered to locations where there is no consistent power supply nor alternatives to power supply to operate the computers.

The governments believe that basic literacy is an important indicator of the potential of their citizens to use ICTs. That is why in Rwanda, since 2006 all government civil servants are sent to do the "International Computer Driving License" computer literacy course. The Tanzania National ICT Policy puts emphasis on having an ICT skilled labour force and in 2015 an ICT Commission was formed to assist in developing professional ICT skills. The implication is that, the ability of the governments to deploy and adopt ICTs is dependent on a core of skilled manpower. The governments believe this manpower plays an important role in technology transfer and capacity building for sustainable development. In addition to that, the governments also understand that the economic growth is also partly driven by the private sector[4] made up mostly by SMEs. From literature review, adequate and appropriate ICT adoption allows a country to realize the impact of technology. Experience in Tanzania and Rwanda shows the following two effects:

- New technologies superseding old technologies, for example, the use of mobile money to transfer money to people in the rural areas instead of sending by post; and,
- New technologies spurring processes affecting businesses and societal change, for example, eCommerce allowing traders to order wholesale items through an on-line platform or drones being used for delivery of blood or medicines to rural clinics and hospitals

To illustrate the above, Table 4 shows comparisons among the East African countries and others on the uptake of the use of mobile money technologies between 2007 and 2012.

[4] The SME policies of both Rwanda and Tanzania

Table 4: Mobile money use in East Africa

Means of sending and receiving money that the business uses					
	Mobile Money	**Post Office**	**Western Union etc**	**Banks**	**send cash with someone**
Uganda	**16%**	1%	2%	17%	**81%**
Tanzania	**14%**	0%	0%	5%	**93%**
Rwanda	**8%**	0%	1%	10%	**70%**
Ethiopia	0%	0%	0%	5%	**55%**
Ghana	0%	1%	1%	12%	**54%**
Cameroon	0%	1%	**26%**	4%	**75%**
Nigeria	0%	0%	0%	11%	**77%**
Namibia	1%	**25%**	1%	41%	**86%**
Botswana	2%	16%	3%	27%	**73%**

Source: www.researchICTafrica.net

Daily internet use has also been on the increased as seen in Figure 10 between 2007 and 2012

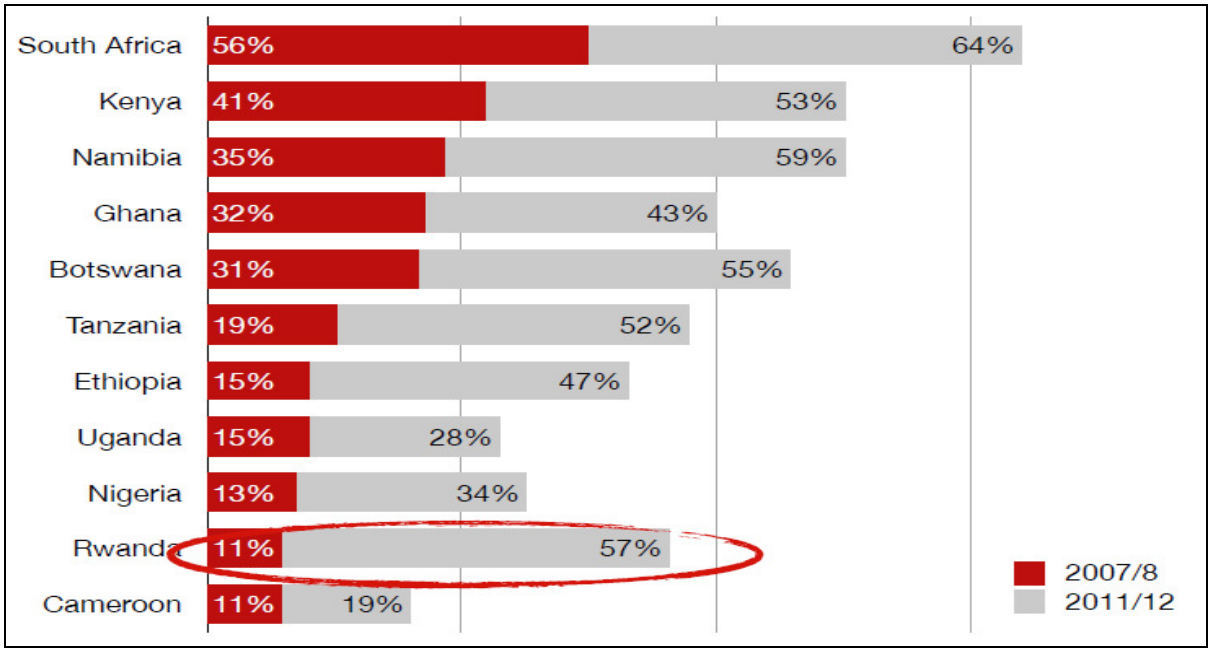


Figure 10: Daily internet us increases from 2007 to 2012
Source: www.researchICTafrica.net

During the past decade national ICT development strategies in Rwanda and Tanzania have transitioned from a focus on infrastructure and institutional development to a shift in

leveraging these assets across a broad range of sectors (e.g. government, education, healthcare)[5]. This transition brings challenges, including balancing this 'application focus' with continuing infrastructure and institutional change

3.2.1 The information communication technology sector in Rwanda

Rwanda is a landlocked country in East/Central Africa 120 km south of the equator in the Tropic of Capricorn. Rwanda is bordered by Uganda to the north, Tanzania to the east, Burundi to the south and the Democratic Republic of Congo to the west. Rwanda is 26,338 sq km in size. Figure 11 shows the map of Rwanda.

Figure 11: Map of Rwanda
***Source**: http://www.rwandagateway.org/*

Rwanda has a population of approximately 12.3 million inhabitants[6]. Life expectancy is around 59.2 years. Literacy rate is just over 71%. The official languages are Kinyarwanda, which is a universal Bantu vernacular and English; French and Kiswahili are used in commercial centers. Rwanda is among the Least Developed Countries (LDCs) with about 90% of the population engaged in (mainly subsistence) agriculture. Its population density of

[5] NICI 3 policy of Rwanda and NICT 2016 policy of Tanzania
[6] *as of July 2014*

340 inhabitants per square kilometer is one of the highest in the world; about 85% of the population lives in rural areas. It is the most densely populated country in Africa that is landlocked with a few natural resources. The major foreign exchange earners are tea, coffee and gorilla tourism. The 1994 genocide decimated Rwanda's fragile economic base and severely impoverished the population, particularly women, and gnarled the country's ability to attract foreign direct investment. Since 2003 Rwanda has revitalized her economy and the GDP has rebounded with an average annual growth of 7%-8% and inflation has been reduced to single digits. Figure 12 shows Rwanda's development finance, Figure 13 the Trade performance and Figure 14 the development indicators.

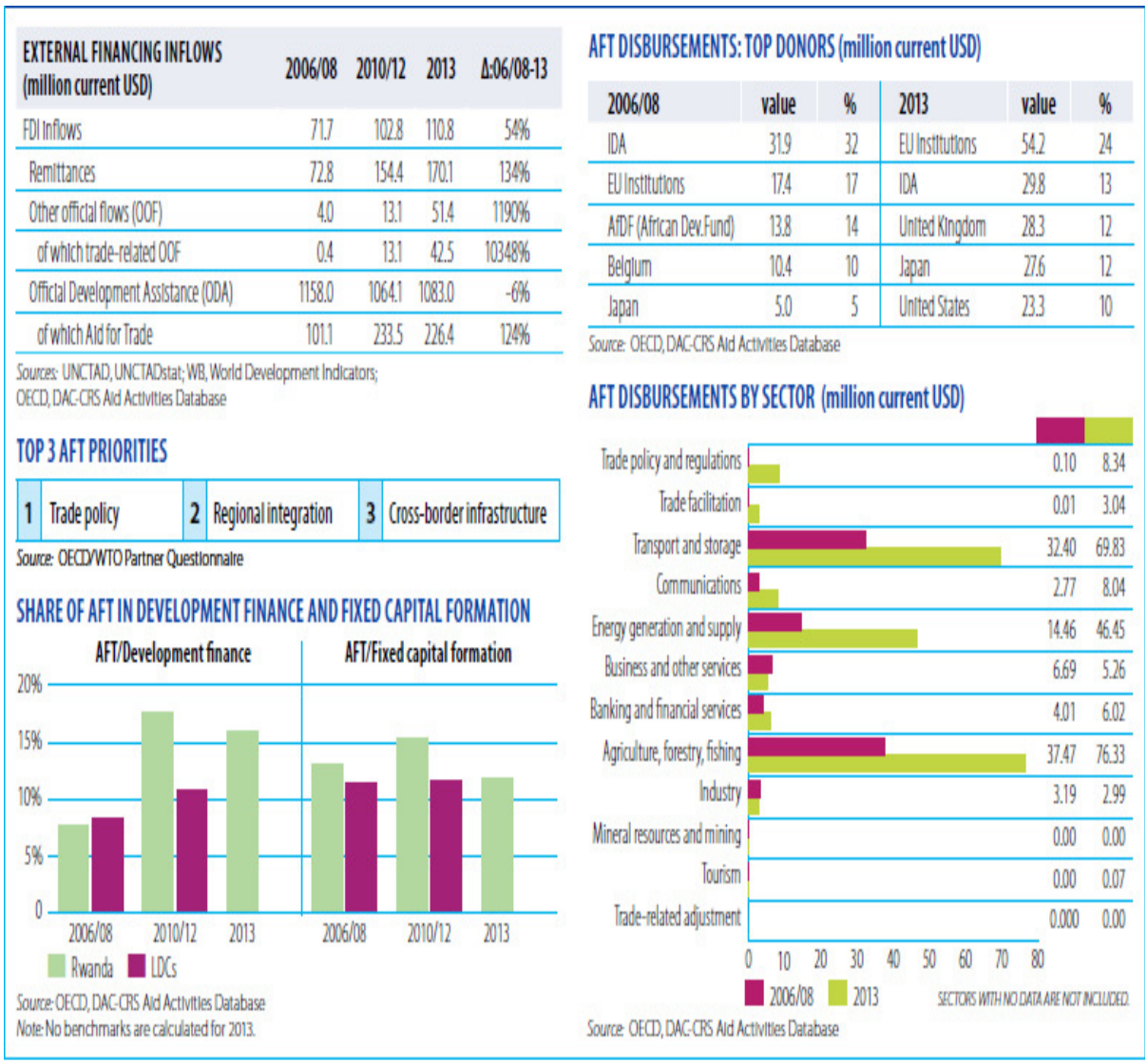


Figure 12: Rwanda Development Finance
Source: https://www.wto.org/english/tratop_e/devel_e/a4t_e profiles_e/rwa_e.pdf

INDICATOR	2006	2013
Trade to GDP ratio (%)	30	47
Commercial services as % of total exports	34	35
Commercial services as % of total imports	30	19
Non-fuel intermediates (% of merchandise exports)	73	59
Non-fuel intermediates (% of merchandise imports)	46	45

Sources: WTO Secretariat; UN Comtrade

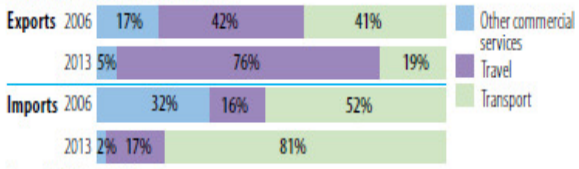
TRADE FLOWS (billion current US$)		2006	2013	Increase	Decrease
Exports	Goods	0.145	0.703	+385% ▲	
	Commercial services	0.074	0.386	+420% ▲	
Imports	Goods	0.488	1.959	+301% ▲	
	Commercial services	0.214	0.472	+121% ▲	

Sources: WTO Secretariat

INDICATOR	2006	2013
Product diversification (based on HS02, 4-dig.)		
Number of exported products (max. 1,246)	134	268
Number of imported products (max. 1,246)	654	776
HH export product concentration (0 to 1)	0.182	0.084
HH import product concentration (0 to 1)	0.022	0.020
Market diversification		
Number of export markets (max. 233)	47	51
Number of import markets (max. 233)	97	118
HH export market concentration (0 to 1)	0.119	0.241
HH import market concentration (0 to 1)	0.055	0.065

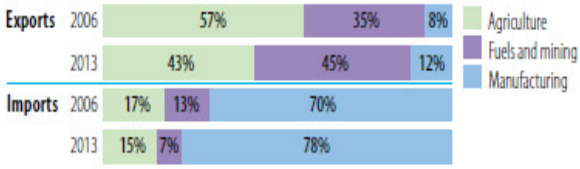
Sources: WTO Secretariat; UN Comtrade

STRUCTURE OF SERVICES TRADE



Source: WTO Secretariat

STRUCTURE OF MERCHANDISE TRADE



Source: WTO Secretariat
Note: Only classified products are included in the calculation.

TOP 5 MARKETS FOR MERCHANDISE EXPORTS (%)

2006	%	2013	%
Kenya	21	Tanzania	41
United Kingdom	21	Dem. Rep. of the Congo	22
Belgium	16	Uganda	14
Hong Kong, China	10	Kenya	13
Switzerland	9	Burundi	3

TOP 5 MARKETS FOR MERCHANDISE IMPORTS (%)

2006	%	2013	%
Kenya	14	China	16
Uganda	13	Uganda	12
Belgium	8	Japan	11
United Arab Emirates	7	India	7
Saudi Arabia, Kingdom of	6	Kenya	7

TOP 5 MERCHANDISE EXPORTS (%)

2006	%	2013	%
Coffee, coffee substitute	34	Ore, concentrate base metals	36
Ore, concentrate base metals	33	Tea and mate	10
Tea and mate	18	Coffee, coffee substitute	8
Passenger motor vehicles, excl. buses	2	Petroleum products	8
Crude veg. materials, n.e.s.	2	Milk and cream	4

TOP 5 MERCHANDISE IMPORTS (%)

2006	%	2013	%
Petroleum products	11	Passenger motor vehicles, excl. buses	10
Medicaments	5	Petroleum products	5
Telecomm. equipment parts, n.e.s.	3	Telecomm. equipment parts, n.e.s.	4
Textile articles, n.e.s.	3	Lime, cement, construction materials	4
Fixed veg. fat, oils, other	3	Medicaments	3

Source: UN Comtrade

Figure 13: Rwanda Trade Performance
Source: https://www.wto.org/english/tratop_e/devel_e/a4t_e profiles_e/rwa_e.pdf

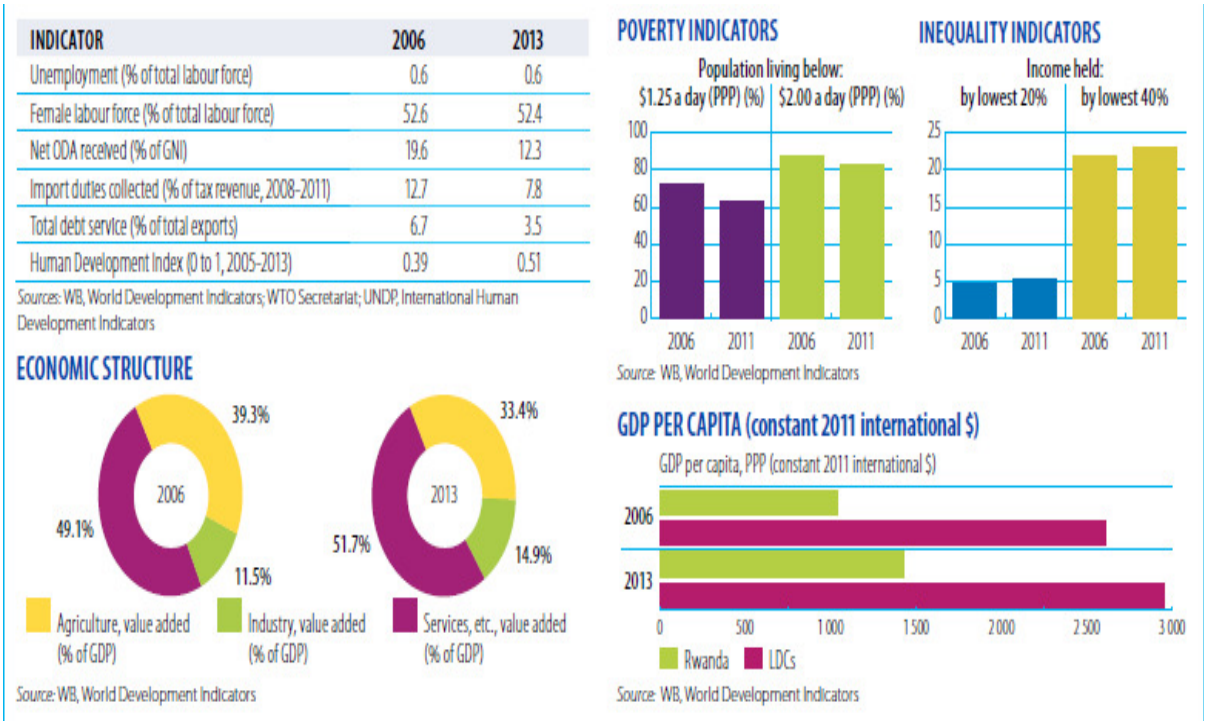


Figure 14: Rwanda Development Indicators
Source: https://www.wto.org/english/tratop_e/devel_e/a4t_e profiles_e/rwa_e.pdf

One of Rwanda's strategy for development is to leverage regional trade and pursue market oriented reforms. Rwanda joined the East African Community and has aligned her budget, trade, and immigration policies to that of her regional partners. Expansionary fiscal policies that go to reduce poverty, improve education, infrastructure are being implemented Energy issues, poor transportation linkages around the country are a challenge encountered by the private sector hampering their growth in 2011, Rwanda completed the first modern Special Economic Zone (SEZ) in the region and is to found in Kigali. The SEZ seeks to draw investment in all sectors, with an emphasis of agri-business, manufacturing and ICT.

3.2.1.1 ICT vision of Rwanda

In a nation with few natural resources, the Government of Rwanda (GoR) is strategizing on the use of ICT in the development of the country. Vision 2020 of the GoR aims to "*transform Rwanda into a middle income country and transition from an agrarian economy to an information-rich, knowledge based society by 2020"*. The GoR recognizes that investment in the ICT sector is likely to yield substantial improvements in the economy (Government of Rwanda 2000:3). In order to change Rwanda into becoming a knowledge-based economy and leap-frog her development, GoR integrated ICT development and systems to enable a

service, information-rich and knowledge-based society that can be globally competitive (Government of Rwanda 2013:65). In 1998 the Rwandan ICT for Development (ICT4D) put in place a process designed to implement policies and plans commonly known as the National Information Communication Infrastructure (NICI) to be implemented starting in 2000. It was to be implemented in four phases with each phase having 5 years of activities. NICI I stressed the importance of developing a favorable ICT policy environment having the necessary legal and regulatory mechanism and removing barriers to the ease of doing business in Rwanda.

The second plan NICI II (NICI-2010 Plan) gave importance to having a communications infrastructure foundation as the backbone for current and future communications requirements. This foundation included increased nationwide coverage of telecommunications networks, versatile and high capacity national optic fiber backbone network, national data center as well as a centralized monitoring and operations center. The third phase of the National Information Communication Infrastructure (NICI) policy, which intends to speed up the introduction of services to exploit the new technologies. The third plan NICI III (NICI-2015 Plan) built on the two previous phases to thrust Rwanda into the fourth phase (NICI IV) of the NICI process. In this phase, importance has been placed on service delivery. This plan allows for easy adaptation of emerging technologies and sectoral changes with coherence. Figure 15 shows the NICI Framework.

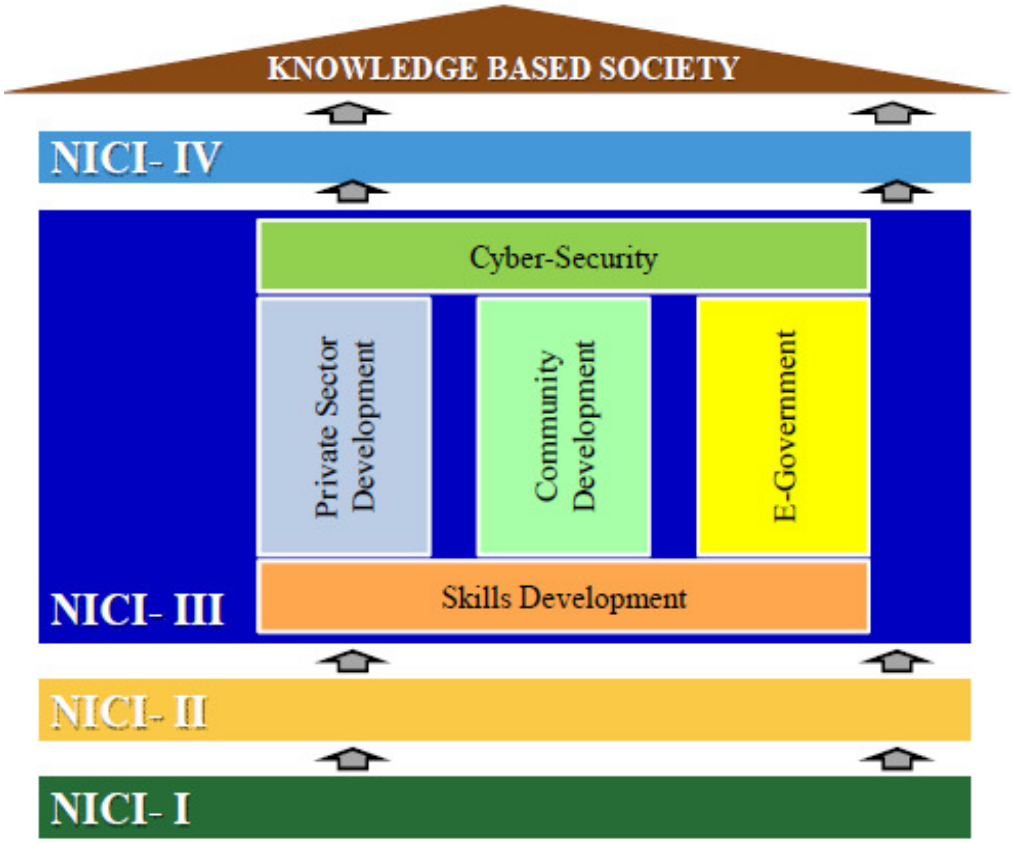


Figure 15: The NICI Framework
Source: Government of Rwanda (GoR). 2010. National ICT Strategy and Plan NICI – 2015. Policy Document

Tafirenyika (2011:18) writes there is an uptake in the use of technology in everyday activities. He cites the smart-card ticketing system known as *twende* used by Kigali Bus Services, which is unleashing rapid changes in the economy and transforming Rwanda. The innovation is altering the way Rwandans go about their daily lives. In a study conducted by Yusuf (2013:65) on the degree in which firms adopted ICT related technologies in their business operations, he finds that seventy percent of the enterprises contacted had adopted ICT related technologies in their business. Of these, thirty percent of the studied enterprises did not include ICT technologies in their business functions. Figure 16 below shows the limiting factors for ICT adoption.

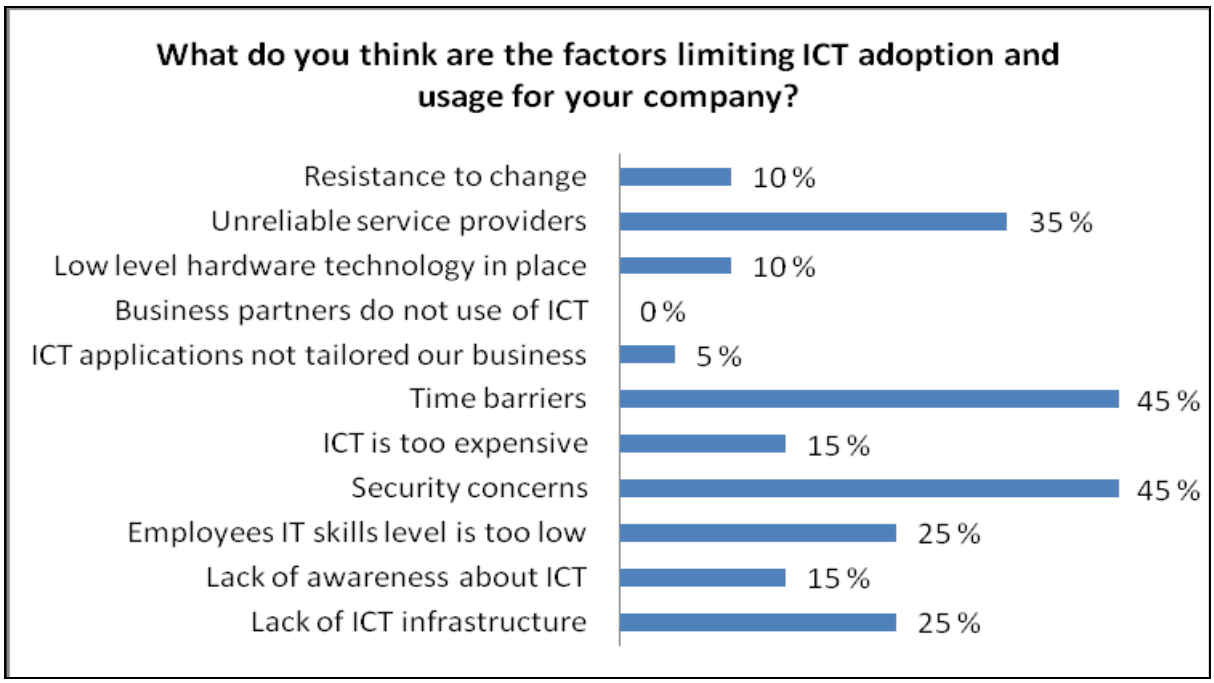


Figure 16: The limiting factors of ICT adoption
Source:http://www.un.org/africarenewal/magazine/april-2011/information-technology-super-charging-rwandas-economy

He concludes the adoption of ICT relies on the mindset, outlook and skills of management in reengineering the business process to incorporate the use of ICT.

3.2.1.2 ICT Infrastructure

Rwanda has a National Fiber Optic Backbone Network connecting the country to the international sea cables through Kenya and Tanzania. This cable reduces the dependency on satellite connectivity making internet access more affordable across the country. To manage content, a National Data Centre has been developed, allowing Rwanda to better manage and secure information storage as well utilize cloud computing applications. Communication, Navigation Surveillance and Air traffic management systems (CNS-ATM) have been deployed, which are revolutionizing communication and broadcasting nationally and regionally. According to the NICI III Strategic Plan (Government of Rwanda, 2010:18), the key achievements include:

- Three telecom operators – MTN, Airtel 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 to 3,548,761 in 2010)
- Internet (1,200 in 2000 to 493,900 in 2010)

- Key ICT Infrastructure deployed including: the National fiber optic backbone; Wireless Broadband network (WIBRO); National Data Centre; Broadcasting infrastructure, communication, navigation and surveillance-air traffic management system
- SMART National ID
- One Laptop per child (56,607 laptops deployed in 113 schools)

3.2.1.3 Technology in the workforce

Given the importance of ICT to the development of the country, the Government of Rwanda has committed significant human and financial resources to its development. This includes development of policies and an institutional framework to develop ICT in the country. There have been and still are some challenges in coming up with an appropriate strategy, of which three major ones need to be enumerated. The first is human resource capacity in low level management ranks. This creates a human resource vicious cycle characterized by frustration of top level management because of low skills at the bottom rung of personnel in institutions, whereby, the institution leaders are under heavy workload while their employees rely on them for every single decision. A possible cause of this human resource vicious cycle can be ascribable to limited human absorption capacity (including skills) at different levels of management in institutions. The second challenge is financial, which most often is not adequate. Most institutions struggle to receive the most important component, which is funding. The third is technology absorption, whereby the institution has no capacity to understand the technology it is to implement, and relies on the creators of the technology to guide them. In this case, if the suppliers have an agenda, it may not be in line with the overall vision of the institution and country as it strives to have sustainable development. As a pre-requisite to ICT development, Rwanda has invested in ICT and technology skills development. The creation in November 1997 of the Kigali Institute of Science and Technology (KIST), an institute of higher learning in science and technology has been an important driver. However, not only are most of these graduates not working in ICT but also this number is far from being sufficient. Most of ICT graduates join different organizations

whereby their primary role is to give computer assistance and troubleshooting support to the department.

3.2.1.4 ICT as an enabler

To enhance ICT as an enabler, the GoR has initiated various programmes, which include:

- Training teachers on the One Laptop Per Child computer programme so as to have better quality and delivery of education;
- Secondary schools are being provided with ICT tools and connectivity through the Schoolnet programme; To spur research and links to global education, higher learning institutions are being interconnected through the RwEdNet programme; and,
- the Rwanda Development Gateway, has been created as a "one stop information centre" that provides Rwanda's information to the rest of the world and is a platform for information sharing.

The above help in the nation's capacity building ad have impacted other initiatives. For example, the agricultural sector has the Agricultural Management Information System (AMIS); an online agricultural produce exchange platform and "e-Soko", a mobile market information solution that allows farmers and consumers to access price information for agricultural products. In defining some of its strategic priorities, the GoR is looking at the following strategies to foster ICT for development in Rwanda:

Accelerate growth of Rwanda Private ICT Sector: Rwandan ICT stakeholders identify the lack of support services to private sector firms and entrepreneurs as a barrier to the success of potential ICT firms, Rwanda being a young nation coming out of the genocide period. Specialized ICT Business Development Services (BDSes) and incubation services are not readily available in Rwanda. It is hoped, grooming of ICT SMEs will begin at the conceptual level of an innovative idea, and will nurture these ideas into start-up firms which will be further supported until they become established firms. The GoR has formed the Rwanda ICT Park, which must tailor its offering to the stages of evolution of different companies in the ICT arena. The idea is to transform innovative ideas into marketable products or services. It is envisaged that not only will technical assistance be available through the ICT Park, but also the would-be "technopreneurs" will be coached to develop business plans and secure financing. For ICT start-ups, the ICT Park will offer incubation services. The plan is that

start-up companies, with a financed young firm as well as "graduated" projects with funding ready to begin operations will receive incubation services, as espoused by Klab in Kigali. These services will include training, technical assistance, information on financing sources, networking, state of the art infrastructure and mentoring. Tech SMEs will receive a combination of incentives and assistance in facilitating their development in Rwanda. Other services will include state of the art infrastructure, networking, reduced rent and facilitated access to markets.

Promote ICT entrepreneurship and innovation: Rwanda wants to promote ICT innovation and culture so as to become a knowledge economy. This promotion will address at least two aspects. First, Rwanda ICT SMEs must create innovative technological solutions, and second, a culture of entrepreneurship has to be fostered in Rwanda.

3.2.1.5 Regulatory environment

The regulatory framework in Rwanda has been enhanced by the following:

- Ratification of telecom law No. 44/2001 of 30/11/2001 as well as the Law No. 39/2001 of 13/09/2001 establishing the Rwanda Utilities and Regulatory Agency (RURA);
- The telecommunication industry being liberalized;
- Enactment of intellectual property rights Law N° 31/2009 of 26/10/2009;
- Ratification of the law governing electronic signatures, messages, transactions; data protection; cyber security and ICT usage in government administrative procedures Law Nº 18/2010 of 12/05/2010

Since its establishment in 2001, RURA adopted International Telecommunications Union ICT industry standards and has been responsible for regulation and licensing in the ICT industry. Another institution that has played an important role in ICT development in Rwanda is the Rwanda Information Technology Authority (RITA), which was later amalgamated into the Rwanda Development Board (RDB). The RDB is accountable for executing and coordinating ICT related policies and initiatives. It is the lead organization coordinating the development and implementation of the National Information Communication Infrastructure Plan. RDB has a role to play in promoting ICT investment

opportunities to attract foreign ICT companies with a potential to bring in expertise and support the whole ICT sector.

3.2.1.6 Environmental challenges

The principle that guides the earlier mentioned strategic plan is that Rwanda can be an innovator developing and producing new technologies and ICT services for local and regional consumers. Regardless of the challenges, the NICI process presents opportunities that can address the challenges over the next years and realize Vision 2020 goals. The private sector has a role to play and based on the writer's observation, there are some constraints to ICT development in the private sector, namely:

i) lack of an entrepreneurial culture;
ii) lack of skills and knowledge;
iii) high cost of connectivity;
iv) low bandwidth and reliability of connectivity.

Other challenges as per the NICI – 2015 document include:

Energy: Rwanda's ICT industry considers the high cost of energy to be an impediment to growth of the industry. Access to electrical power is not easy and only 13% of the population has access to electricity. Electricity generation cost is high and the feed in tariff of power is high with 184 RWF/kWh for households and RWF 126/kWh for industries as of 2015, despite GoR subsidizing the utility by 30.4 billion RWF. Rwanda's electricity cost at $0.24/Kwh or 24 US c/Kwh is at least double that of its neighbors. This challenge is an opportunity for the generation of sustainable green energy, transmission and distribution also through a SMART electricity grid and renewable energy designs.

Limited access to finance: The financial lending institutions in Rwanda still require adequate fixed collateral for ICT firms to borrow money, of which they rarely have on hand. This is compounded by an insufficient legal and regulatory environments and inconsistent skills for assessing and managing risk. Limited lending can also be attributed to Rwanda's low savings rate that stood at 15.3 percent of GDP in 2013.

Inadequate International bandwidth: Rwanda being landlocked, has leased capacity on the fibre optic cables from its neighboring countries to the international underwater sea cables in Mombasa, Kenya and Dar es Salam, Tanzania. This has increased the cost of connectivity for the ICT industry in Rwanda. To reduce this dependency, the strategy is to have links to the

sea cable through southern Africa and satellite back-up, with a virtual landing point in the country that can be accessed by local telecommunication providers.

Low ICT awareness and usage: The role of ICT in economic and social development is still not yet understood, mainly due to the lack of ICT awareness, insufficient local content and limited rural ICT penetration.

Nascent Private Sector: The private sector, particularly the ICT sector, in Rwanda is relatively small, but a technology park has been created to cater to the growth of innovative start-ups in the private sector. This will be supported by a national access network to increase broadband penetration and to create business connectivity access models that are affordable and enhance ICT growth.

Limited interoperability of government systems: Legacy systems were built in terms of silos and were paper intensive. Each government entity did its own ICT implementation without thought of inter-operability or standards. This resulted in duplication and improper usage of resources. By putting in place e-Government initiatives, it can improve government operational effectiveness and efficiency, thereby improving service delivery to citizens.

Inadequate ICT skills: The NICI policy is geared to have more ICT professional knowledge and skills developed to increase Rwanda's ICT skills base. Lack of skills, both entrepreneurial know-how and technical skills are also defined as a major barrier to the development of ICT in Rwanda. Entrepreneurship in the Rwandan context is rarely pursued, even less so among highly educated technical specialist who are sought after by government and established SMEs.

3.2.1.7 Understanding of the Rwandan SMEs

Rwanda's Vision 2020 identifies six priority pillars and three cross-cutting areas for the transformation of the Rwandan society. One of the pillars is the development of the SME sector, spearheaded by innovation, competitiveness and entrepreneurship. Thus, the role of Rwanda's Small and Medium Enterprises becomes crucial for the development of the Rwandan economy. SMEs comprise 98% of all the establishments; micro-sized establishments - those employing between 1 and 3 people - account for 92.6% of all establishments while enterprises with only one worker account for 72% of all establishments. Table 5 indicates the defined SMEs whereby two of the three conditions must be met.

Table 5: SME Categories in Rwanda

Size of the Enterprise	Net capital investments (Million RwF)	Annual Turn over (Million RwF)	Number of Employees
Micro Enterprises	Less than 0.5	Less than 0.3	1 to 3
Small Enterprises	0.5 to 15	0.3 to 12	4 to 30
Medium Enterprises	15 to 75	12 to 50	31 to 100
Large Enterprises	More than 75	More than 50	More than 100

Source: GoR Small and Medium Enterprises Development Policy

A 2008 Rwanda Private Sector Foundation (PSF) study estimated that there are over 72,000 SMEs operating in Rwanda, while only 34 percent of them are formal registered entities, the rest being informal. This study found most SMEs are formed to add extra income to middle to upper income households. Rwandan small and micro businesses need to be skilled in the proper usage of basic accounting and financial systems. Rwandan medium sized enterprises need other types of skills, like the knowledge to acquire appropriate technologies and be able to customize the technologies for better efficiencies and quality production.

Combining these categories shows that SMEs comprise approximately 98% of the total businesses in Rwanda and account for 41% of all private sector employment as shown in Figure 17 below.

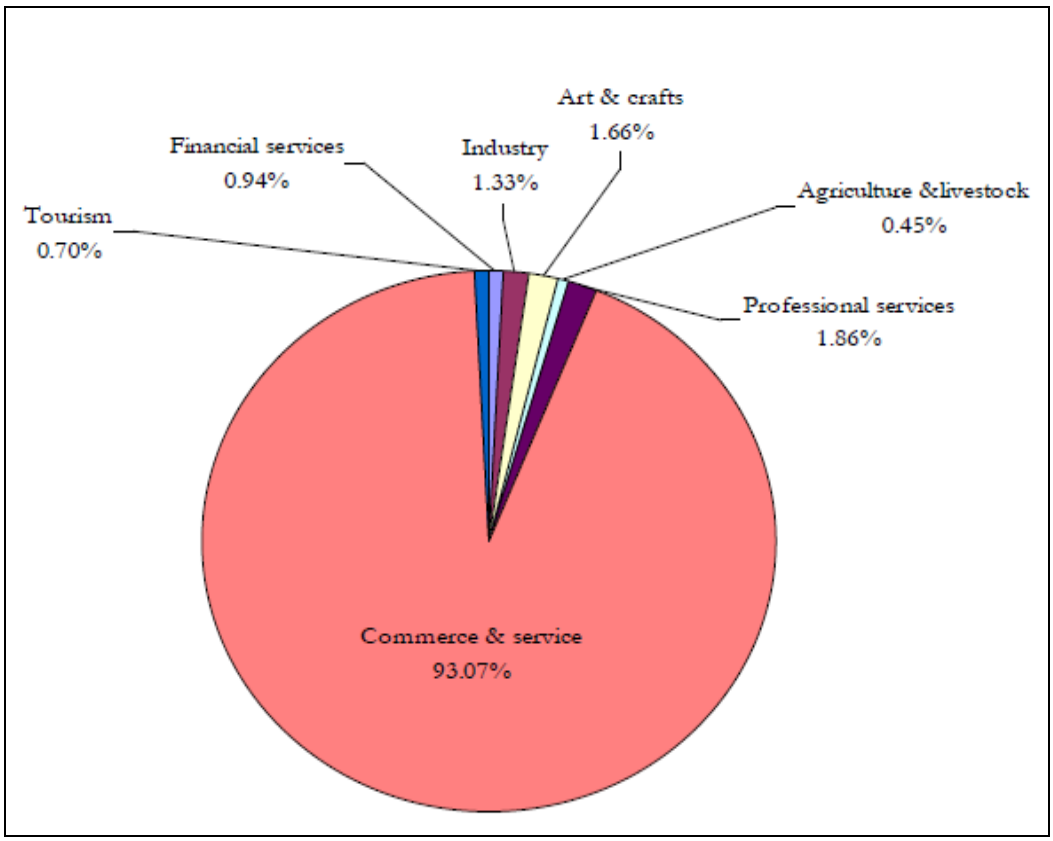


Figure 17: SME Operators by sector
Source: Rwanda Business operators census report 2009 in GoR SME Development Policy

Rwanda's SMEs still face several problems as they vie to play a pivotal role in Vision 2020 which sees Rwanda as a middle-income country. While small and medium-sized enterprises are the driving force of Rwanda's economy, they still face challenges such as limited access to knowledge and practical skills, limited access to information and technology, limited access to finance and management of resources, and limited access to markets and market information. As a results, the Government of Rwanda designed the Small and Medium Enterprise Policy framework with the goal of implementing a coherent and coordinated policy to create an enabling environment for the growth of the SME sector. The idea is to develop a critical mass of viable and dynamic SMEs significantly contributing to the national economic development with the use of technology, both as a tool and as an enabler. With the

SME policy and the Vision 2020, which is ICT centric, the use of ICT could enable SMEs not only to improve efficiency but also to impact the national economy

3.2.2 The information communication technology sector in Tanzania

Tanzania is in East Africa bordering the Indian Ocean between Kenya and Mozambique. Tanzania is bordered by Kenya and Uganda to the north, Rwanda and Burundi to the North West, Democratic Republic of Congo to the west, Zambia to the South West, Malawi and Mozambique to the south. Tanzania is 947,300 sq km in size. Figure 18 shows the map of Tanzania.

Figure 18: Map of Tanzania
Source: http://www.mapsofworld.com

Tanzania has a population of about 44.7 million inhabitants (as of July 2013). Life expectancy is around 61.2 years. The official languages are Kiswahili (universal Bantu

vernacular) and English. Tanzania is among the least developed countries and her economy depends on agriculture, tourism and minerals, the latter two contributing to high growth rates. Tanzania has a liberalized market economy, though the telecommunications, banking, and energy sectors still have government ownership. Agriculture provides 85% of exports, and employs about 80% of the work force. Banking reforms have also been spurred financial investments and the financial sector has expanded with foreign-owned banks accounting for about 48% of the banking industry's total assets. All land in Tanzania government owned the land is leased for either 33 years or 99 years renewable. GDP growth in 2009-13 was a respectable 6-7% per year due to high gold prices and increased production. Figure 19 shows Tanzania's development finance, Figure 20 the Trade performance and Figure 21 the development indicators.

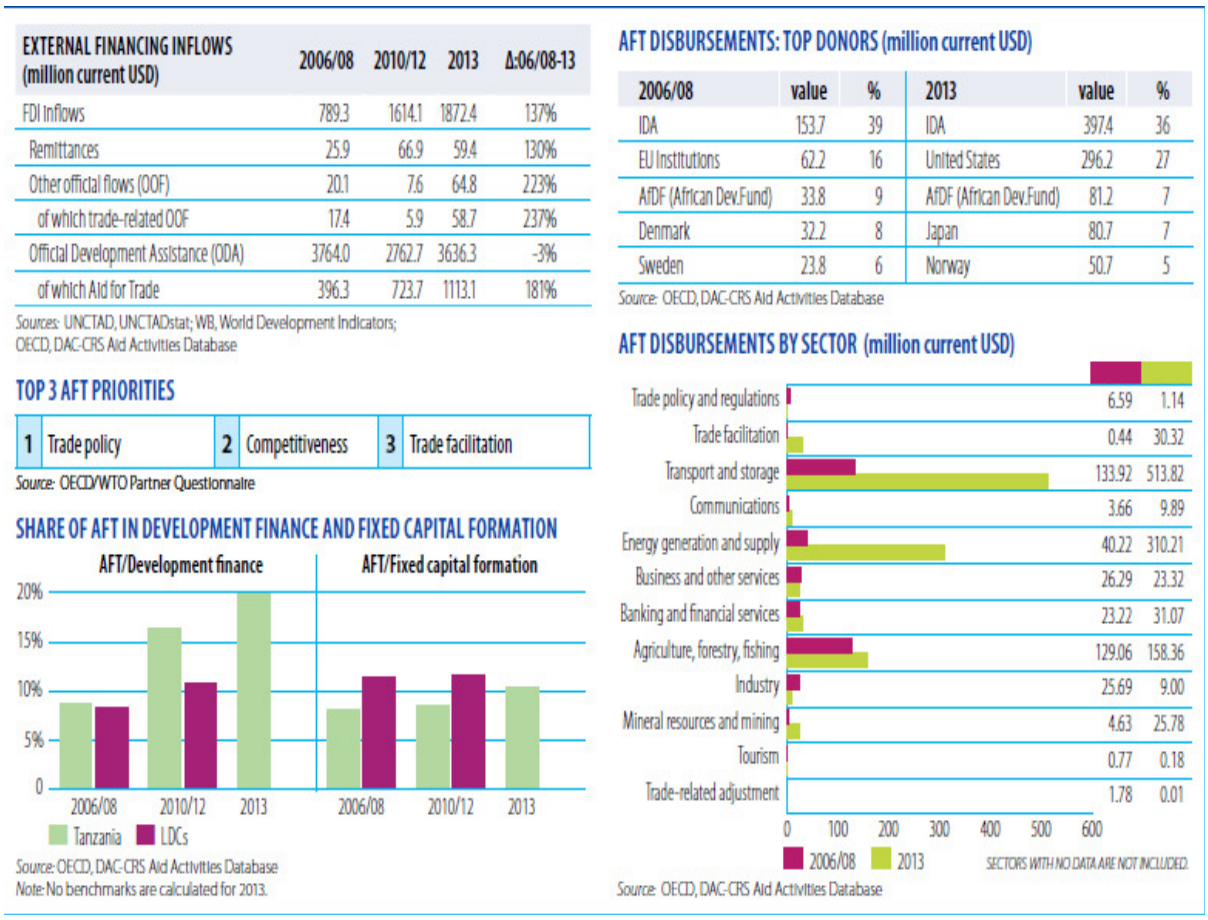


Figure 19: Tanzania Development Finance
Source: *https://www.wto.org/english/tratop_e/devel_e/a4t_e/profiles_e/tza_e.pdf*

INDICATOR	2006	2013
Trade to GDP ratio (%)	59	66
Commercial services as % of total exports	43	36
Commercial services as % of total imports	24	18
Non-fuel intermediates (% of merchandise exports)	76	74
Non-fuel intermediates (% of merchandise imports	44	37

Sources: WTO Secretariat; UN Comtrade

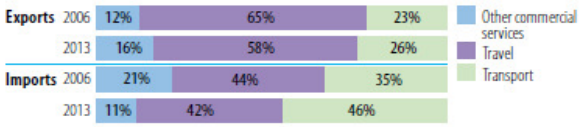
TRADE FLOWS (billion current US$)		2006	2013	Increase	Decrease
Exports	Goods	1.918	5.370	+180% ▲	
	Commercial services	1.467	2.979	+103% ▲	
Imports	Goods	3.864	11.035	+186% ▲	
	Commercial services	1.212	2.444	+102% ▲	

Sources: WTO Secretariat

INDICATOR	2006	2013
Product diversification (based on HS02, 4-dig.)		
Number of exported products (max. 1,246)	527	685
Number of imported products (max. 1,246)	958	996
HH export product concentration (0 to 1)	0.132	0.136
HH import product concentration (0 to 1)	0.064	0.143
Market diversification		
Number of export markets (max. 233)	118	132
Number of import markets (max. 233)	131	138
HH export market concentration (0 to 1)	0.076	0.079
HH import market concentration (0 to 1)	0.052	0.079

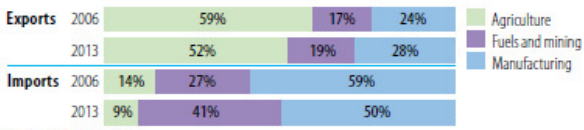
Sources: WTO Secretariat; UN Comtrade

STRUCTURE OF SERVICES TRADE



Source: WTO Secretariat

STRUCTURE OF MERCHANDISE TRADE



Source: WTO Secretariat
Note: Only classified products are included in the calculation.

TOP 5 MARKETS FOR MERCHANDISE EXPORTS (%)

2006	%	2013	%
Switzerland	19	South Africa	17
South Africa	15	India	17
China	8	Switzerland	9
Germany	6	China	7
Netherlands	6	Dem. Rep. of the Congo	5

TOP 5 MARKETS FOR MERCHANDISE IMPORTS (%)

2006	%	2013	%
South Africa	13	India	18
United Arab Emirates	11	Switzerland	13
Bahrain, Kingdom of	9	China	13
China	7	United Arab Emirates	10
Japan	6	South Africa	6

TOP 5 MERCHANDISE EXPORTS (%)

2006	%	2013	%
Gold, nonmontry excl. ores	33	Gold, nonmontry excl. ores	35
Precious metal ores, concentrates	10	Precious metal ores, concentrates	7
Fish, fresh, chilled, frozen	9	Fruit, nuts excl. oil nuts	4
Tobacco, unmanufactured	5	Coffee, coffee substitute	4
Coffee, coffee substitute	4	Oilseed (soft fixed veg. oil)	3

TOP 5 MERCHANDISE IMPORTS (%)

2006	%	2013	%
Petroleum products	23	Petroleum products	37
Fixed veg. fat, oils, other	5	Passenger motor vehicles, excl. buses	2
Passenger motor vehicles, excl. buses	4	Wheat, meslin, unmilled	2
Telecomm. equipment parts, n.e.s.	4	Tubes, pipes, etc., iron, steel	2
Goods, spec.-purpose transport vehicles	3	Goods, spec.-purpose transport vehicles	2

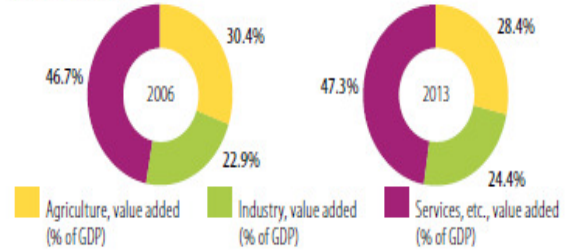
Source: UN Comtrade

Figure 20: Tanzania Trade Performance
Source: *https://www.wto.org/english/tratop_e/devel_e/a4t_e/profiles_e/tza_e.pdf*

INDICATOR	2006	2012
Unemployment (% of total labour force)	4.3	3.5
Female labour force (% of total labour force)	50.0	49.8
Net ODA received (% of GNI)	13.3	10.3
Import duties collected (% of tax revenue, 2006-2012)	...	14.4
Total debt service (% of total exports)	2.5	1.9
Human Development Index (0 to 1, 2005-2013)	0.42	0.49

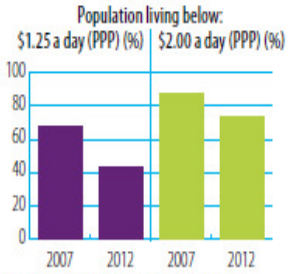
Sources: WB, World Development Indicators; WTO Secretariat; UNDP, International Human Development Indicators

ECONOMIC STRUCTURE

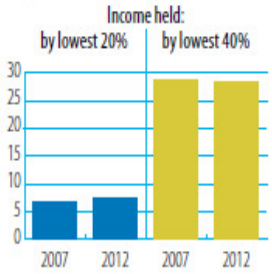


Source: WB, World Development Indicators

POVERTY INDICATORS

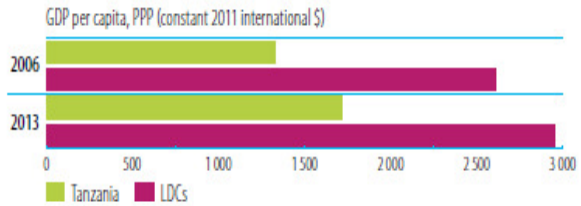


INEQUALITY INDICATORS



Source: WB, World Development Indicators

GDP PER CAPITA (constant 2011 international $)



Source: WB, World Development Indicators

Figure 21: Tanzania Development Indicators
Source: *https://www.wto.org/english/tratop_e/devel_e/a4t_e/profiles_e/tza_e.pdf*

3.2.2.1 ICT vision of Tanzania

It is also noteworthy that Government of Tanzania (GoT) Vision 2025 document (Government of Tanzania 2000:21) explicitly includes ICT by noting, "*The new opportunities that ICT is opening up can be harnessed to meet the goals of the Vision*". The National ICT Policy reflects the goals, objectives and aspirations that would lead to the realization of Vision 2025 through the use of digital opportunities. This is based on eight (8) pillars that relate to Vision 2025 as set out below:

- ICT-Leadership and Human Capital Development
- ICT Access and Infrastructure Development
- E-Services and Local Content Development
- Local, Regional and International Cooperation
- Legal, Regulatory and Institutional Framework
- ICT Safety, Security and Standardization
- ICT Sector and Industry Development
- Productive Sectors Development

Taking into account Tanzania's Vision 2025 and the medium term plans to achieve Vision 2025, the Tanzania 2016 National ICT Policy is designed to aid Tanzania's development process by contributing to addressing the nation's key developmental challenges. These include:

- Providing life skills to a youthful population and the challenges of turning the youthful population into productive an asset for economic development
- Developing a human resource that is professional, technical and has managerial skills
- Growth of an under-developed research and development (R&D) capacity and a scientific research system that leads to commercialization and market access by created SMEs
- Increase the low technology transfer and capacity absorption that fosters the growth of indigenous Technology SMEs to enter external markets
- Develop the under-developed and/or under-utilized physical and communications and telecommunications infrastructure, with their inherent legal and regulatory framework.

The digital developments of the last decade since creation of the first National ICT Policy in 2003 have brought to the fore a number of issues and concerns which the Government has been taking steps to address. The Government of Tanzania has recognized the importance of ICT in the growth of her economy, especially when the current emphasis is on industrialization. One of the government priorities is to improve ICT infrastructure to bridge the digital divide and reduce the cost of communications. The government is also levelling the ground through development and implementation of policy and Legal framework aimed at attracting investments in the sector. The GoT recognizes the role of open data and data analytics, in particular when information is a resource which is generated, collected and secured, then organized and analyzed for decision making and national prosperity.

It is acknowledged that the development, deployment and utilization of ICTs within the economy and society, raises a number of challenges. These include those of having to do with infrastructure, safety, security, standardization, skills and leadership to champion the integration of ICTs in the socio-economic development process. The importance of ICT for development in Tanzania is illustrated by the adoption of the National ICT policy by the government early in May 2016, the strengthening of the e-Government Agency and the formation of the National ICT Commission. This was done to catalyze the usage of both ICT and science, technology and innovation (STI) for sustainable development and have impact on the GDP of the country. The rate of change in usage of ICT can be exemplified by the telecommunications sector, whereby leapfrogging growth rates demonstrate the changing transformation of the ICT landscape. As seen in Figure 22, the number of mobile phone subscriptions is approaching 39.67 million in 2015 in a country of approximately 40 million inhabitants.

Year	2010	2011	2012	2013	2014	2015
Fixed	174,511	161,063	176,367	164,999	142,950	142,819
Mobile	20,983,853	25,666,455	27,450,789	27,442,823	34,108,851	39,665,600
Total	21,158,364	25,827,518	27,627,156	27,607,822	34,251,801	39,808,419
Penetration	50%	59%	61%	61%	71%	79%

Figure 22: Subscription and teledensity
Source: http://www.tcra.go.tz/

Over the last ten years, there has been high telephony penetration in the rural areas and this is amplified by the increasing number of mobile application services, such as eBanking, agricultural information and micro-payments, that have become available for citizens to take care of day-to-day activities in business, social and private life. Yonazi (2012:5) identifies four issues with a potential to facilitate the implementation of ICT for development in Tanzania. They are

- ICTs being accessible and affordable;
- Easy adoption of technologies that are readily available;
- Soft infrastructure, like Kiswahili language, being available and supportive in the usage of these adopted technologies; and
- The government providing its commitment to ICT usage.

He observes that, projects with strong leadership conviction and commitment tend to be successful (e.g. the Sengerema community centre project). Also, projects stagnate when committed leadership ceases, (e.g. the Kilosa community centre project). Equally, inadequate planning; unsupportive policies, practices and processes; and organizational inertia affect the application of ICT in development activities. He describes three people-related issues as important for the application of ICT for development, namely, adequacy of ICT skills, ICT awareness and mindset and it is imperative they be enhanced. He draws Figure 23 to show the current challenges of ICT for development. On a continuum of adequacy line, the low side of the continuum of adequacy illustrates the challenges and the facilitators to address the challenges on the high side. Addressing a challenge may create a solution that is on the high adequacy side, while ignoring a facilitator may create a problem and shift it to the low side of the adequacy line. Therefore, efforts have to be taken to mitigate the challenges, exploit and advance facilitators in order to maintain them on the high side of the continuum of adequacy line.

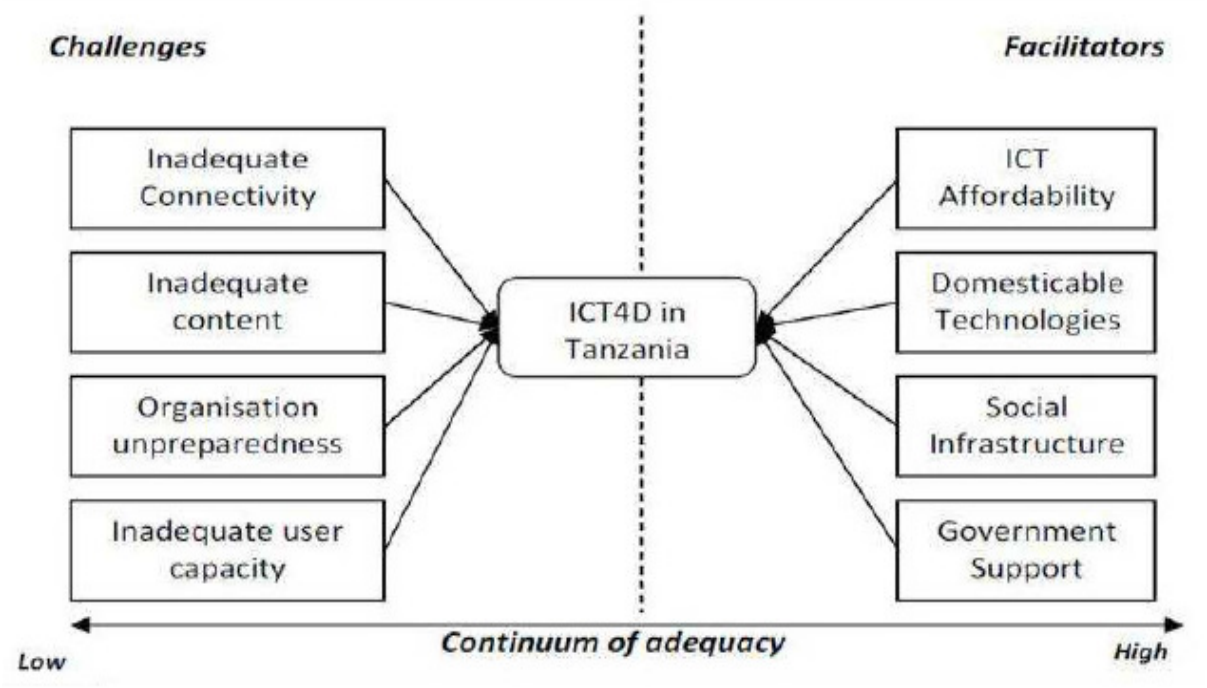


Figure 23: Facilitators and challenges of ICT for development in Tanzania
Source: Journal of e-Government Studies and Best Practices IBIMA Publishing

Regardless of the achievements there are bottlenecks encountered that need to be overcome. These include:

- Infrastructure: Impact on access and affordability – the use of ICT in rural areas will be hampered by bad or insufficient soft and hard infrastructure and increase the price of connections.
- Finance - ICT investments and implementation seems to be driven by low public funding and higher donor funding leading to the need for balancing investments to have ownership by the nation, especially in critical sectors like health, agriculture, education, to name a few.

3.2.2.2 ICT infrastructure

Having a landing point linked to the underwater international sea cable from Seacom, has spurred interest from telcom operators in Tanzania resulting in further investments in infrastructure to increase available broadband. The government is laying down the national backbone in collaboration with telephone operators. Operators are encouraged to share infrastructure, including base stations. Internet coverage around the country has not grown at

a fast pace. Prior to the first international submarine fiber cable in July 2009, Tanzania depended on satellite links for connectivity outside the country resulting in high connection fees. With regards to internet penetration Tanzania still lags behind other countries in the region with similar GDP per capita and literacy levels. Telcom operators are filling in the void by providing internet services through their network broadband infrastructures. Recently, Halotel has installed fibre in the rural areas to support the National Fiber Backbone (NFB), which is being built through government partnership with the private sector, particularly major mobile operators.

The backbone will network all regional headquarters within the country and connect Tanzania with its eight neighbors: Kenya, Uganda, Rwanda, Burundi, Democratic Republic of Congo, Zambia, Malawi, and Mozambique. Tanzania's teledensity is at 61 percent of the population and the mobile phone subscribers are around 11 million people (TCRA 2013). The Public Switched Telephone Network (PSTN), using fiber optic, microwave and satellite-based links, is now over 95% digital, with the coverage of the network infrastructure is widening to rural areas. Overall the market added 44,000 lines by end of March 2013, including fixed and mobile, for a total 27.6 million subscribers. Furthermore, Tanzania's broadcasting sector has a liberalized framework with broadcast operators licensed to operate nationally and locally over a large geographic area.

3.2.2.3 Technology in the workforce

There has been a lot of improvement in adopting and using ICT in day to day activities. With the introduction of mobile money products such as M-Pesa, Tigo Pesa, Airtel Money, Halotel Pesa, TTCL Pesa and Ezy Pesa, people have now been able to send and receive money and also pay various utilities through mobile services. In addition, various banks have started offering banking services which allow their customers to use mobile phones to do banking transactions. However, there is limited e-transaction such as e-commerce services. As much as there has been an impetus to have a national payment system and the use of local debit cards, the legislative framework appropriate for e-business is not yet conducive to supporting the services. The legal framework does not yet provide an enabling environment for there to be trust in e-business transactions.

It is widely acknowledged that adoption of ICT in the governance services has significant positive impact in the governance services including efficiency in the delivery of public services. In the document on e-Government strategy (Government of Tanzania 2012:12), it has been indicated that there is low level of application of ICT services in the public sector in Tanzania. The only aspect that has been widely adopted in the Government is the organizational web portal. Other ICT services particularly those which allow interaction and/or transaction with Ministries, Independent Departments and Government Agencies (MDAs) are still rare in the public sector in Tanzania. A majority of staff in the Government have an average knowledge and skills on the use of ICT in their activities. Also, the level of ICT skills and knowledge for non-ICT staff in the GoT Agencies is still at marginal level.

3.2.2.4 ICT as an enabler

ICT usage in education enhances effective delivery of learning services. Unfortunately this benefit is seen in schools and higher learning institutions found in cities and not rural areas. The inadequacy of effective programme for training teachers on ICT particularly computers and other multi-media utilization has been identified as a major reason for slow take up of computer studies in schools. In this respect, private learning institutions and schools are far better than their public owned counterparts. The software development industry is experiencing a slow growth, whereby, a few local companies are developing computer application packages. As much as there is a growth of locally developed mobile applications, the majority of software used in computers is developed by external companies outside the country. Also, there are no local manufacturers of ICT equipment and other associated hardware in Tanzania. Overall, Tanzania has a small emerging skilled capacity to support the ICT industry in terms of developing or supporting hardware and software.

3.2.2.5 Regulatory environment

The establishment of the Tanzania Communication Regulatory Authority (TCRA) in 2003 enabled the effecting of a Converged Licensing Framework (CLF) in 2005. Under the CLF, TCRA today issues four types of licenses namely: Network Facility (NF); Network Service (NS); Application Service (AS); and Content Services (CS) categories, while phasing out the old licenses. At the end of 2013 there were 21 network facility operators; 17 network service operators; 91 application service operators; 85 radio content service operators; and 30

television content service operators. The TCRA (2013:2) report shows that voice subscribers (both fixed and mobile) increased from 768,449 in 2003 to 27,022,927 in September 2013 and Tanzania's teledensity currently stands at 60% of the population. It should be noted that, in 2012, Tanzania successfully started migrating to a new television broadcasting digital transmission. Three companies are licensed as multiplex operators (signal distributors) in Tanzania.

3.2.2.6 Environmental challenges

Being a least developing country, Tanzania does have its environmental challenges. The Government recognizes the need to target the draft STI policy and the recently launched 2015 National ICT Policy at addressing the key developmental challenges facing Tanzania, which include:

The challenges of motivating the youthful population to play an innovative role in economic development activities: The lack of strategic policies and initiatives targeted at turning the youthful population into a skilled and ICT knowledgeable human resource asset to aid the development of the country may translate into a high unemployable population in the years to come. Tanzania needs to develop youth who are entrepreneurial and job creators

The disproportionate informal private sector: The Tanzanian private sector has a large informal sector, which has no skills in the usage of ICT. The informal private sector is also by far the largest employment sector of the Tanzanian economy – accounting for close to 58 percent of the economically active population, while the formal private sector accounts for only about 11 percent (Trade Mark South Africa 2012).

A human resource with inadequate professional, technical and managerial manpower base: There is a low percentage of key technical and professional ICT staff in Tanzania. This little professional and technically skilled human resource capacity of the economy is one of the key developmental challenges facing the country.

Under-utilized communications infrastructure: The development, expansion and the modernization of the nation's communications infrastructure is a challenge which is currently being tackled. The key developmental challenge is the uptake in the usage of this infrastructure so that it brings benefit to the community and SMEs that become catalysts for business growth, for both rural and urban centers, supported by universal service and access to communication services.

The challenge of linking Investment Promotion to technology transfer and inherent agreements: The communications sector in Tanzania has grown to technology acquisition from outside Tanzania into the country, supported by foreign direct investment (FDI). This has brought about more operational expertise and some limited knowledge transfer. Unfortunately, there lacks a strategic framework for knowledge and technology transfer that will allow the telecommunications sector is to continue to grow and expand in a sustainable manner having impact on the economy of the country.

The challenge of publishing Intellectual Property and its recognition as an asset: The ICT sector most times is intellectual property (IP) driven with a lot of R&D. Tanzania has little patent registration and publication among its ICT companies/people, indicating low R&D in the ICT sector.

Fostering Technology SMEs through government support: For the main part, government has been the largest enabler for procuring and adopting new technology (infrastructure mostly). The challenge is to create a programme that sees the growth of indigenous SMEs that can solve government and community problems while creating jobs and playing a role in the development of the economy in a formal manner

3.2.2.7 Understanding of the Tanzanian SMEs

Tanzanian SMEs provide one third of the Gross Domestic Product (GDP) contributed by approximately 2.7 million enterprises in the country, out of which about 60 percent are located in the urban areas. The majority (98 percent) of these are micro enterprises (employing less than five people). Most (66%) of the micro and small enterprises have an annual turnover of less than US $2,000. SMEs are work in the following sectors: trade (54%) followed by services (34%), according the Tanzanian SME policy (GoT, 2003). The SME development policy of 2002 gives prominence to their role in national economic development. The main focus is the creation of an enabling business environment, development of access to financial and non-financial services, and having a supportive institutional infrastructure. There is no universally accepted definition of SME. The Tanzanian yardsticks are the total number of employees, total investment and sales turnover. The SME policy of Tanzania categorizes this as shown in Table 6 below:

Table 6: SME Categories in Tanzania

Types of Business (Category)	Employees	Capital Investment in Tanzania Shs[7]
Micro Business	1 to 4	Up to 5Million
Small Business	5 to 49	Above 5 Million to 200 Million
Medium Business	50 to 99	Above 200 Million to 800 Million
Large Business	Over 100	Above 800 Million

Source: Tanzania Government SME Development Policy of 2003

Nchimbi and Olomi (2002:9) allude to the roles of key stakeholders who are needed to implement the Tanzanian SME policy. Various stakeholders have come together and the current Tanzanian SME support landscape can be illustrated in Figure 24 below:

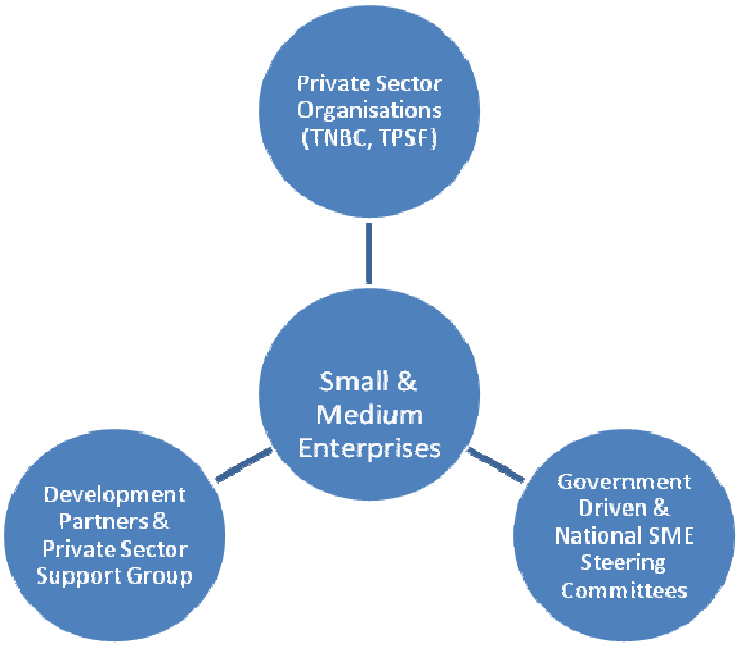


Figure 24: Tanzanian SME Support Landscape
Source: http://www.ukessays.com/essays/economics/current-status-of-sme-sector-in-tanzania-economics-essay.php

[7] *1 US Dollar = Tanzania Shs 1,580 as of May 2012*

The landscape illustrates that the government is getting support of the donor community and the private sector to drive the implementation of the SME policy and other jointly done mechanisms. SMEs have contributed to job creation and wealth creation, but they are still faced by numerous barriers. The rural program on enterprise development (RPED) surveys found barriers to general operations and also barriers impeding growth. The report concludes with a list of factors acting as barriers as follows:

- No access to credit;
- Entrepreneurial education and skills at low levels;
- Very little marketing and managerial skills; and,
- Cumbersome legal and regulatory framework allowing entities getting legal status.

Acknowledging the Tanzanian SMEs face challenges, the factors hindering their development in Tanzania can be put into five categories namely: macro-economic and policy environment, physical and technological infrastructure, the banking and finance structure, legal and regulatory framework, and market conditions.

3.3 Synopsis of three country case studies that used ICT for development

In order to understand how other countries managed to progress from a least developing country to a developed country, a qualitative analysis was done of two developed countries (South Korea and India) and one advanced least developed country (Kenya).

3.3.1 Case Review - South Korea

South Korea is a recent success story of technological catch-up, particularly in ICTs, and has managed to have the world-first deployments of 3G telecommunication networks and a forerunner in usage of internet and digital broadcasting. South Korea was named the world's most advanced ICT economy according to the latest annual study from ITU (2012:20). The report added:

> *"The country has made ICT development a policy priority and integrated its use in many aspects of society. The Korea Communications Commission continuously works towards transforming the country into a "smart powerhouse" by effectively regulating a highly dynamic and competitive*

telecommunication market and pushing forward innovations and improvements..”

The South Korean Government has put in place a master plans that propels the use of ICT and broadband infrastructure as a development framework. In the process, the Government has outlined broad policy objectives, including for example:

a) plans for incentives and public investment in infrastructure to enhance broadband usage;
b) increase digital literacy of the nation, have initiatives to promote e-Government services and e-Commerce;
c) promotion of universal access around the country; and
d) have venture capital market incentives, which can support R&D and industrial growth.

The master plans sought to support specific economic sectors and were evaluated periodically to assess impact. This impact was catalyzed by the government making public investments and having initiatives that include the private sector and trying to evolve into larger investments. Prior to the 1980s and early 1990s, the government was successful in modernizing and expanding the telephone and national backbone networks. The next phase was the agenda to promote national *informatisation.* According to the Ovum Consulting report (2009:79), the Korean Informatisation Promotion Committee (KIPC) defines informatisation as *“the process in which information can be generated, distributed, or utilized to enable society to function more effectively and efficiently*”.

The Informatisation Promotion Fund was created after the 2006 revision of the 1995 Framework Act on Informatisation Promotion. The fund gets contributions from government through spectrum licensing fees and private sector and the money is used to support ICT-related R&D, to develop and diffuse standardization in ICT industry, to train ICT human resources, among other things in support of e-Government, especially projects that are difficult to implement of national interest. The fund has also been used to support a number of venture capital companies. The following Figure 25 highlights the success of South Korea’s ICT strategy.

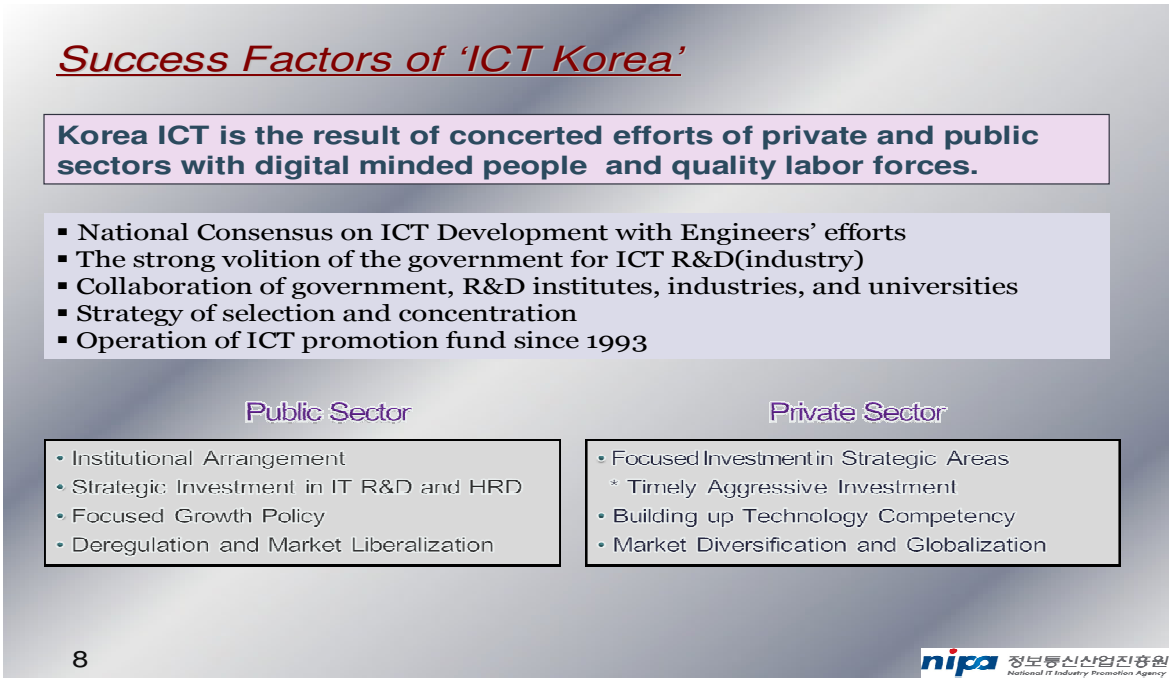


Figure 25: Success Factors of ICT Korea
Source: ICT Promotion Policy and R&D in Korea, NIPA Korea (Ovum Consulting report)

In implementing her policy, South Korea has faced some challenges, mainly standards within a specific industry and the policy adjustment over time. The issue has been whether to regulate (single or multiple standards) or leave it to market forces, a very critical decision in policy formulation. Also the challenge of policy adjustment has been to take into account the shift between the paradigms of technology standards and R&D policies as they shift from infant policies towards mature policies.

3.3.2 Case Review - India

In this current era, knowledge is the primary input in the economic activities of a country. A knowledge economy (KE) and a knowledge-based society form the basis of the visions of least developing nations. In India, the information infrastructure has been constantly improving to encourage a KE since the 1990s. The country has a vision and has put in place strategies to transit to a KE. India is one of the global leaders in ICT and a large exporter of knowledge workers (Gosh and Gosh, 2009:187). India has been investing in building education and skills of human resources, strengthening its innovation system, and bolstering its information infrastructure. Hung (2008:38) observes that the Indian government has sponsored R&D projects with a view to reducing or avoiding imports of technology, as well as gain an edge with respect to some of these technologies. India has three pillars for KE,

namely good education, use of information communication technologies and applying innovation

As a policy, state governments have been supported by the central government to establish biotechnology and software technology parks. Other economic sectors at the grass root level, like in agriculture, are being empowered in the use of ICT. Private/public partnerships have been established across India and many corporate organizations are collaborating with non-governmental organizations, local self-help groups for various social development and social welfare programmes. Three reasons are defined by Gosh et al (2009:188) for the development of knowledge-based societies:

a) India has a well educated professional human resource in the STEM subjects with a good command of English, which is flexible to learn new skills under the right circumstances;

b) The Indian diaspora in the developed western world plays a role in knowledge transfer and are domain experts who can nurture a new generation of India-based thought leaders; and,

c) The Indian entrepreneurial and business community now has the capacity to support the government to address the challenges and barriers that impede the government's vision of being a knowledge economy.

Nevertheless, India faces some challenges, which include poor rural ICT infrastructure and broadband networks. It is estimated that rural internet penetration is about 9 percent, compared with urban penetration of 64 percent as of the beginning of 2015. Another problem is that there are more than 22 languages and scores of dialects besides illiteracy of the rural people. Due to the literacy level being low, capacity building is not easy leading to the people lacking technical knowledge about the different software of the computer. The above adds to the notion that those who benefit are not the very poor but those who are already in a relatively privileged position. Also, for the strategies aimed at development to be successful the literature indicates there is a crucial need for major attitudinal and institutional change in order for an ICT-based initiatives to be successful. The challenge is also to absorb appropriate ICT tools to leverage business advantage and growth.

3.3.3 Case Review - Kenya

In 2003, the Ministry of Information and Communication of the Government of Kenya (GoK) developed Kenya's ICT policy which was updated in 2006. The vision of this policy

as stated in the national policy Government of Kenya (2006:1) is, "*a prosperous ICT-driven Kenya society*" and the mission is "*to improve the livelihoods of Kenyans by ensuring the availability of accessible efficient, reliable and affordable ICT services*." This policy is currently under review so as to align it with the new constitution of Kenya and economic blueprint Vision 2030. Vision 2030 has the overall objective of realizing higher and more sustainable economic growth in a more equitable environment, accompanied by increased employment opportunities. The vision states ICT sector plays a role by facilitating the provision of equitable and affordable quality information and communication services throughout the country. The draft Kenya national ICT policy currently in public circulation, takes into consideration the aspects of ICT communication, hardware, software, applications and content. Four guiding principles are considered, namely: infrastructure development; human resources capacity building; cooperation between stakeholders; and appropriate policy and regulation framework according to government policy (GoK, 2006:9). The policy seeks to achieve the following:

- Catalyze wealth creation and poverty eradication with sustainable economic growth and development,;
- Attain progress towards full socio-economic inclusion of all citizens (including women, youth, rural and other disadvantaged groups) through the provision of universal access;
- Increase access and investment in the ICT services sector; and,
- Stimulate innovation with R&D in the ICT sector

The GoK Master Plan for ICT (2013/14 – 20117/18) is a roadmap that works to achieve Vision 2030 in creating a knowledge economy and socio-economic growth. This Master Plan has three foundations and three pillars. The first foundation is the development of a quality ICT human resource on the grounds that having ICT human capital and workforce is critical for an integral and sustainable development. The second foundation is Integrated ICT infrastructure. This is the provision of an integrated infrastructure backbone to allow cost effective delivery of ICT products and services to the whole country. Finally, the third foundation is an Integrated information infrastructure that wants to improve the quality of e-Government services and enable the country to transition to a knowledge-based society and achieve Vision 2030.

With regards to the pillars of the Master Plan, the first pillar is the production of quality products for export by the ICT businesses community and SMEs. The second pillar is ICT as a driver of industry. It aims to significantly increase productivity, global competitiveness and growth. The third pillar is e-Government services. The goal is to have good governance through improving productivity and efficiency. The ICT strategy seeks to achieve the following:

- Reduce duplication of efforts and resources among government entities by enhancing collaboration;
- Deliver timely information and government services to the citizenry to improve Kenya's competitiveness;
- Provide products and services digitally to the citizens and businesses, including SMEs and so reduce transaction costs and wastage; and,
- Provide a forum for citizens' to provide feedback to government initiatives and activities.

So far, the Kenyan experience shows that the following factors have been critical to the successful implementation of ICT policies and strategies:

- Commitment and leadership by senior management: The creation of a Ministerial Committee on ICT in Kenya that uses ICT shows leadership that the rest of government can follow;
- Public-private partnership: The government making public-private partnership key in the investment of ICT projects to assist in having adequate budgetary provisions. This is based on case studies in Germany, Finland and Estonia, which highlight the importance of public-private partnerships in implementing e-government;
- Enabling legislation: For the ICT strategy to succeed, it requires a legal and regulatory framework that allows for the initiatives to be undertaken and goals to be met; and,
- Monitoring and Evaluation: The impact of the initiatives has to be seen and measured through an articulated methodology with metrics for evaluating strategy implementation developed, discussed, and approved.

While Kenyan SMEs may use ICT for communication, social networking and general information acquisition, these SMEs are not aware of the opportunities offered by ICTs for business growth and wealth creation, a challenge that is yet to be addressed.

Chapter 4 Conceptual model of research

This research looks at three main aspects of ICT that support SMEs from the perspective of a least developing country, viz:

i) capacity building;

ii) sustainable development; and,

iii) transfer of ICT/technology.

It is premised that sustainable economic growth is possible if it is underpinned by appropriate technology transfer with capacity building and learning through best practices (Earth Institute 2015:12, Pearce et al, 2012:42). ICT policies formulated in both Rwanda and Tanzania have the goal of their countries develop to become middle-income countries with SMEs being part of the catalyst for growth. The discussions in the literature on the one hand expose the wildly optimistic views about the opportunities provided by new technologies for development, and on the other hand the pessimistic perceptions about the capabilities of the least developed countries to exploit these technologies to their benefit (Earth Institute, 2015:12). It is important for Rwanda and Tanzania to have an understanding of the links and dependencies (if any) in between ICT transfer, capacity building and sustainable development. This is crucial in order to implement the appropriate strategies to support SMEs grow. Chandra (2008:6) stipulates it is important to make the right development choices with respect to human, scientific, technological, organizational, and institutional resources to have capacity absorption. Thus, technology transfer has to be designed in such a way that it is compatible to both the source and the recipient environments. Technology leapfrogging could be a chosen strategy, but it can only occur if absorptive capacity forms part of the economic development strategy in Rwanda and Tanzania.

One significant investment area for leapfrogging ICT transfer in Rwanda and Tanzania is human resource, essentially because the process of technology transfer is person-oriented and individual technical skills are required (James, Kartano and Miller, 2004:4). Human capital, skills and expertise are essential in putting ICT to good use in the development of a country. The most valuable asset of a knowledge society is its intellectual capital. One path to building this intellectual capital in Rwanda and Tanzania is through higher learning institutions (HLIs). Alumanah (2006:4) finds that ICT is increasingly fundamental to social and economic development. Valdaliso, Elola, Aranguren and Lopez (2011:708) argue that absorptive capacity based on economic clusters like ICT, involves two interlinked aspects,

namely the creation of relationships with extra-cluster sources of knowledge; and the structural characteristics of the intra-cluster knowledge system.

From a policy perspective, Hoekman, Maskus and Saggi (2005:1597) observe that policies that spur national economic growth are wide-ranging, from education to provision of funds for technology creation and acquisition to tax incentives capital equipment expenditure. Making these policies and strategies known, allows the Rwandan and Tanzanian society to be better informed and have a collective approach to development. Moving towards an inclusive information society in a knowledge economy requires a common understanding of the nature, scope of challenges, opportunities and initiatives. It should be noted that, building such consensus that is sustainable for strategies emanating from technology policies is an evolving process.

To ascertain if there are any linkages between technology transfer, capacity building and sustainable development, this research used two approaches. First, using a qualitative approach, a literature review, interviews, surveys using questionnaires and case studies are done. The literature review was conducted that collated information and communication technologies transfer, capacity building and sustainable development factors. A case study of several countries with recent histories of information and communication technologies enabled development was done. Second, a quantitative analysis using three Delphi studies of the collated factors was performed with participants (also involving small and medium enterprises) from Rwanda and Tanzania. Finally, the results were analyzed with the help of a software package to find the correlation between information and communication technologies, capacity building and sustainable development.

4.1 Research Hypothesis

Literature review including that of Amadi-Echendu and Mulamula (2009:4) and Amadi-Echendu and Mulamula (2010:3) indicates there is little empirical evidence of how the diffusion and application of information and communication technologies (ICTs) can be a catalyst in SMEs for economic development and growth in LDCs. It is postulated in the paper by Amadi-Echendu and Mulamula (2010:3) that technology transfer/diffusion through incubation of ICT-based SME's can lead to capacity building for sustainable economic

growth. This is even when it is hypothesized that most SMEs in LDCs operate with poor ICT infrastructure, non-conducive regulatory environment (though the policy maybe favorable for SME growth), cannot easily access credit, do not have sufficient markets for their products, use outdated technology and have no sufficient training and skills. To be part of the global markets, these SMEs have to be supported to grow and be on a footing comparable to their competitors, in terms of technology usage and skills capacity absorption.

The starting point for the proposition is that there is a probable linkage between ICT transfer (TT) and capacity building (CB), and there is a probable linkage between ICT transfer (TT) and sustainable development (SD), which does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis. This thought process justifies the application of the Delphi study so as to:

(i) Explore the perceptions of a judgmental sample that was thought to be sufficiently aware of the subject matter;

(ii) Establish some consensus with respect to the wide ranging factors selected with regards to TT and CB;

(iii) Establish some consensus with respect to the wide ranging factors selected with regards to TT and SD;

Proposition: *Policy formulation in a least developing country needs to articulate the correlation between ICT transfer and capacity building of SMEs in order to enhance sustainable social and economic development.*

The following hypotheses are examined in the study:

Null hypothesis (H_0): The correlation between information communication and technology transfer, capacity building and sustainable development does not exist. This leads to the following alternative hypothesis:

H_1: There is a link between ICT transfer and human capacity development.

H_2: There is a link between ICT transfer and sustainable development.

H_3: There is a link between human capacity development and sustainable development.

The **research thesis** is then: *In LDCs it is necessary to establish the extent of linkages or correlation between ICT transfer, capacity building and sustainable development, in order to develop and implement appropriate policies and strategies that foster growth of small and medium enterprises..*

4.2 Research Methodology

4.2.1 The Delphi study

The Delphi technique was conceived to be a group communication process that looks to conduct detailed examination of a specific matter for the purpose of goal setting, policy investigation, or predicting the occurrence of future events. It is an iterative process used to collect and distill the judgments of knowledgeable people or experts using a series of questionnaires interspersed with feedback. Delbecq, Van de Ven, and Gustafson (1975:11) write that the Delphi technique can be used to get the following objectives:

- To establish or build up a range of possible program choices;
- To discover or showcase underlying ideas or information leading to different conclusions; and,
- To look for information which may produce a consensus on the part of the respondent group

Both qualitative and quantitative techniques can be used in the Delphi process. The Delphi technique, utilizes multiple iterations to get a consensus of opinion with regards to a certain issue. Ludwig (1994:54) states the process is an iteration of two or three rounds is enough for most research: in each round every participant works through a questionnaire which is returned to the researcher.

The first round starts with an open-ended questionnaire which serves as the foundation for soliciting specific information about a content issue from the Delphi subjects. Upon receiving subjects' responses the collected information is converted into a structured questionnaire. This questionnaire is used as the survey instrument for the second round of data collection. It is common practice to use a structured questionnaire in Round 1 that is based on extensive review of the literature (Ludwig, 1994:55). In the second round, each Delphi participant is asked to review the items summarized based on the information provided in the first round and rate or "rank-order" items to establish perceived priority items to get a consensus of actual outcomes. In the third round, each Delphi participant receives a questionnaire that includes the items and ratings as per the second round and they provide further clarifications of both the information and their judgments on the significance of the items.

Selecting research participants is an important component of Delphi research as it is their expert judgment upon which the output of the Delphi is based on. There is no specific criterion for selecting Delphi participants. Individuals can participate if they have a related background and experience in relation to the matter to be studied and can contribute to attaining consensus (Kaplan, 1971:24).

Ludwig (1994:52) notes that the number of participants used in a Delphi study is "*generally determined by the number required to constitute a representative pooling of judgments and the information processing capability of the research team*". If the sample size of a Delphi study is too small, these subjects may not be considered as having provided a representative pooling of judgments regarding the target issue and if the sample size is too large there is a possibility response time may be too long. However, what constitutes an optimal number of subjects in a Delphi study never reaches a consensus in the literature. It is suggested that ten to fifteen subjects could be sufficient if the background of the Delphi subjects is homogeneous. Ludwig (1997:2) documents that the majority of Delphi studies have used between 15 and 20 respondents.

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4.2.2 Delphi study shortcomings

There are shortcomings of the Delphi study. First, there is a possibility of low responses from the participants, especially when four iterations or higher are conducted from the same participants (Witkin & Altschuld, 1995:196). Furthermore, if a few of the participants stop providing responses halfway, the quality of information obtained could be discounted or at least critically scrutinized.

Second, it is assumed the selected Delphi participants have equivalent knowledge and experience, an assumption that may not be correct. Some participants may have much more in-depth knowledge of certain topics, whereas others may have knowledge in other topics (Altschuld & Thomas, 1991: 187). The outcomes of the two groups of participants may result in general statements or opinions instead of in-depth analysis of ranking of the subject matter.

4.2.3 The methodology for the research

The strategy for doing this research is to read, observe, interview, conduct surveys use questionnaires and do case studies. The population for the survey is made up mainly of subjects from the following groups: ICT policy makers, implementers of ICT plans and strategies and the end users (Government and Private Sector), NGOs, learning institutions. It is a process that is both qualitative and quantitative. The first and second round Delphi studies conducted attempts to establish the highest ranked ICT technology transfer, sustainable development and capacity building factors. The intention is to identify factors in the questionnaire and the parameters which could be used to examine the perceived relationships between technology transfer, capacity building, and sustainable development in a least developing economy. The third round Delphi study is done to get some consensus with respect to the wide ranging factors selected regarding technology transfer/diffusion and capacity building for SMEs. Figure 26 illustrates the process.

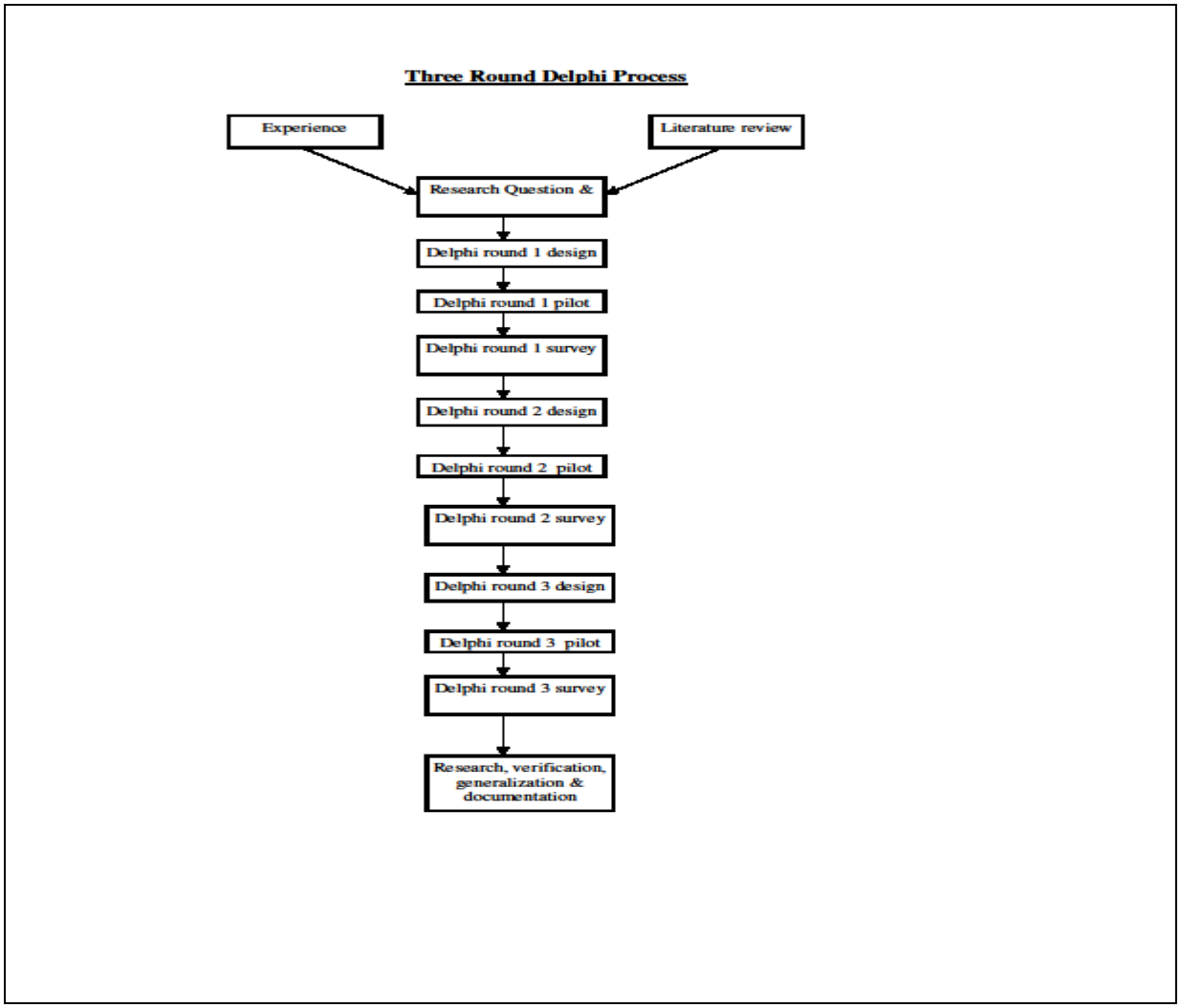


Figure 26: Three round Delphi process

With regard to survey respondents, the following key characteristics are taken into account: education of the receiving user, knowledge of the technology prior to transferring it, time frame to understand and adapt the technology to the local environment, innovation in the utility of the technology to enhance its functionality in the local environment, the constraints of the technology (prior, during and after the technology transfer), impact of the technology to the user and community/SMEs in terms of any form of development. Questionnaires were sent out to these groups followed by interviews to get appropriate data. The scope of the data collection from the questionnaire and interviews was geared towards getting information and perceptions on the ICTs transferred in relation to the above mentioned characteristics. Specific data sought included information on: assessment of technology needs, technology information, enabling environments, capacity building, and framework for technology transfer.

Case studies were done on South Korea, India and Kenya to get best practices[8]. These practices would then be used to formulate suggestions for appropriate policies and strategies that assist in leapfrogging sustained development with technology transfer and capacity building schemes in least development countries. Finally, using a software package known as SPSS (Laerd Statistics 2016), the respondent data from the third Delphi study is input into the software for analysis on normality, significance and to seek any correlation between information and communication technology, capacity building and sustainable development factors. The results then inform on the implications for any possible correlations.

[8] At independence, Tanzania and South Korea had similar economic status, and now South Korea has progressed further than Tanzania. India has had relations with Tanzania since the colonial times and Kenya is a member of the East African Community like Tanzania & Rwanda, but more economically advanced.

Chapter 5 Data Collection

5.1 First Delphi Study

This first phase Delphi process was to establish the highest ranked technology transfer (TT), capacity building (CB), and sustainable development (SD) factors. The intention was to identify factors and the parameters which could be used to examine the perceived relationships between technology transfer, capacity building, and sustainable development in a least developing economy. The objective was to establish the linkage between ICT transfer modalities, capacity building factors and sustainable development. In order to establish and use these factors to further the research, testing of the significance of the factors was done through a survey of a judgmental sample of respondents from two least developed countries, namely Rwanda and Tanzania.

Based on considerable literature review by Amadi-Echendu and Mulamula (2009:4), technology transfer factors, sustainable development factors and capacity building factors were identified. The questionnaire was sectioned into three parts, each addressing between 30 and 50 factors respectively for TT, SD and CB. In taking the view that the subject matter may mean or evoke different meanings, a glossary of the terminologies used was provided. We selected 100 respondents from participants attending a regional conference on technology and knowledge transfer held in Kigali, Rwanda. The respondents were mostly academics and professionals of varying disciplines and persuasions, but all with a reasonable awareness of ICTs in Rwanda and Tanzania. The respondents were asked to rank each factor by placing a value of 1 (Not Important {NI}) or 2 (Average {A}) or 3 (Very Important {VI}). Thirty three respondents returned their filled out questionnaires. On getting back the ranked questionnaires, using a spreadsheet, the mean and standard deviation were calculated as follows:

$$\text{Mean} = \text{Sum}\ (xf/f), \text{ and}$$

$$\text{Standard Deviation} = \sqrt{\ } ((x^2)f - (f * (\text{Mean}^2)))/(f - 1))$$

where x is the rank as a weight, f is the frequency of each rank under NI, A, and VI for each factor.

Following the above calculations, the resulting means (with corresponding factors) were sorted in descending order. A low standard deviation indicated clustering around the mean. A high standard deviation indicated the respondents had divergent ideas on the importance of the addressed factor. Our analysis concentrated on factors having low standard deviations, but having high means. The assumption was that, a high mean meant a greater number of respondents felt the factor was very important. The perceived important factors by the respondents in each of the three tables are shown below: Table 7.1 - Technology Transfer Factors, Table 7.2 - Sustainable Development Factors and Table 7.3 - Capacity Building Factors.

Table 7.1: Technology Transfer Factors

No	Technology Transfer Factors	Glossary	Mean	St Dev
1	Adequate infrastructure	The basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function.	2.67	0.60
2	Technical assistance	Assistance to understand the science of the technology	2.64	0.49
3	Involvement of private sector	Private sector playing a role	2.64	0.60
4	Knowledge of opportunities	Knowing the available chances and possibilities in technology transfer	2.64	0.60
5	Understanding local needs	Knowledge of the local requirements	2.64	0.60
6	Quality of transferred technology	Standard of technology to be conveyed	2.55	0.62
7	Involvement of government	Government playing a role	2.55	0.71
8	Recipient's knowledge level	How well-informed the receiver is	2.52	0.62
9	Know-how transfer	Expert skills, information, or body of knowledge that (1) imparts an ability to cause a desired result, (2) is not readily available, and is (3) outside the public domain, that can be transferred	2.48	0.67
10	Involvement of local community	Local community playing a role	2.48	0.71
11	User needs	Requirements of recipients	2.48	0.71
12	Nature of technology	Type of material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques	2.42	0.50

13	Criteria for technology transfer	Standard of judgment of the process of sharing of skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments and institutions	2.42	0.71

Table 7.2: Sustainable Development Factors

No	Sustainable Development Factors	Glossary	Mean	St Dev
1	Enabling environment	The expression that encompasses government policies that focus on creating and maintaining an overall macroeconomic environment that brings together suppliers and consumers in an inter-firm co-operation manner	2.76	0.44
2	Economic sustainability	The idea that future generations should have the same or greater access to economic resources as the current generation.	2.73	0.57
3	Access to internet	Ability to go online onto cyberspace	2.67	0.48
4	Technology innovation capability	The capacity to create new things in the field of technology	2.64	0.60
5	Appropriate use of technology	Proper use of the technology	2.61	0.61
6	Monitoring and evaluation	Monitoring refers to an ongoing process of assessing whether the process of planning and implementation is proceeding on target; evaluation, is an assessment of whether the various goals and objectives have been met.	2.61	0.61
7	Research and development	Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications	2.61	0.61
8	Availability of basic ICT tools	Accessibility of simple technologies for gathering, storing, retrieving, processing, analyzing and transmitting information	2.52	0.67
9	Availability of skilled workforce	Access to workers who have a pre-set amount of knowledge	2.52	0.67

Table 7.3: Capacity Building Factors

No	Capacity Building Factors	Glossary	Mean	St Dev
1	Availability of resources	Accessible of personnel and major items of equipment, supplies, and facilities that are available for assignment to incident operations	2.76	0.44

2	Training of end users of technology	Educating the recipients who will be users of the technology	2.76	0.44
3	Training of technical staff	Educating the implementers of the technology	2.76	0.44
4	Readiness for absorption of technology	Being ready for technology integration of change and innovation into an organization's culture and operations	2.73	0.45
5	Incentives for new technologies	Stimulation for the creation of new ideas and things	2.70	0.47
6	Support for capacity building institutions	Assistance to entities that do the following: Human resources development/training, Education/building awareness, Institutional strengthening, including local participation	2.70	0.47
7	Knowledge transfer	Transfer of skills acquired by a person through experience or education and what is known in a particular field or in total	2.64	0.60
8	Infrastructure services	Services offered to physical structures hosting transferred technologies	2.61	0.66
9	Higher Learning Institution curricula matching transfer needs	Content of the course of study in Universities and Colleges	2.59	0.61
10	Collaboration and networking	Working together and inter-connecting with other people and entities	2.58	0.50
11	Locally adapted	Changed to suit local environment	2.58	0.61
12	Policies and Regulations	Legal instruments and the associated rules that are to be administered	2.55	0.51
13	Nurturing knowledge-based development	Cultivating information-based development	2.55	0.62

5.2 Second Delphi survey

This second phase of the research continued to refine the initial factors and the parameters which could be used to examine the perceived relationships between ICT technology transfer, capacity building and sustainable development in a least developing economy. The result of the responses from the same respondents is summarized in three separate tables as follows: Table 8.1 - Technology Transfer Factors, Table 8.2 - Sustainable Development Factors and Table 8.3 - Capacity Building Factors. In each of these Tables, the Columns are described as follows: Column 1 - Name of the Sub-Factor, Column 2 - Glossary of each Sub-Factor, Column 3 - Mean of the respondents' answers for each Sub-Factor, and Column 4 - Standard Deviation of the respondents' answers for each Sub-Factor.

Table 8.1: Technology Transfer Factors iteration 2

No	Technology Transfer Factors	Glossary	Mean	St Dev
1	Adequate infrastructure	The basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function.	2.67	0.60
2	Technical assistance	Assistance to understand the science of the technology	2.64	0.49
3	Involvement of private sector	Private sector playing a role	2.64	0.60
4	Knowledge of opportunities	Knowing the available chances and possibilities in technology transfer	2.64	0.60
5	Understanding local needs	Knowledge of the local requirements	2.64	0.60
6	Quality of transferred technology	Standard of technology to be conveyed	2.55	0.62
7	Involvement of government	Government playing a role	2.55	0.71
8	Recipient's knowledge level	How well-informed the receiver is	2.52	0.62
9	Technology evaluation capability	Capacity to assess the technical, economic, and competitive value of a technology.	2.52	0.67
10	Technology incubators	Technology programs designed to accelerate the successful development of entrepreneurial companies through an array of business support resources and services,	2.52	0.67
11	Medium of information exchange	Transmission materials/conduits that allow recipients to receive information	2.48	0.62
12	Know-how transfer	Expert skills, information, or body of knowledge that (1) imparts an ability to cause a desired result, (2) is not readily available, and is (3) outside the public domain, that can be transferred	2.48	0.67
13	Involvement of local community	Local community playing a role	2.48	0.71
14	User needs	Requirements of recipients	2.48	0.71
15	Commercialization of technology	Transactions (sales and purchases) having the objective of supplying technology commodities (goods and services)	2.43	0.68

16	Nature of technology	Type of material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques	2.42	0.50
17	Consumer technology targeting	Strategizing the use of technology by specific end-user groups	2.42	0.66
18	Criteria for technology transfer	Standard of judgment of the process of sharing of skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments and institutions	2.42	0.71
19	Country guiding technology transfer	Government showing the way in technology transfer	2.36	0.65
20	Licensing	Document giving permission under contract	2.36	0.65
21	Generation of Innovation	Creation of new ideas/things and/or a new way of doing something	2.36	0.70
22	Appropriate technology application	Usage of a labour intensive, low technology, capital saving method of working which, is more suited to relatively impoverished, less developed countries suffering from high unemployment and under employment	2.33	0.60
23	Absorptive capacity	Ability to value, assimilate, and apply new knowledge	2.33	0.74
24	Speed of transfer	How fast the conveyance occurs	2.33	0.74
25	Strategic partnering	Structured collaboration between organizations to take joint advantage of market opportunities, or to respond to customers more effectively than could be achieved in isolation.	2.30	0.64
26	Incentive culture	Factors (financial or non-financial) that enables or motivates a particular course of action in the set of shared attitudes, values, goals, and practices that characterizes an institution, organization or group.	2.30	0.77
27	Risk analysis	A technique to identify and assess factors that may jeopardize the success of a project or achieving a goal.	2.27	0.63
28	Technology marketing ability	The capability to have an integrated communications-based process through which individuals and communities are informed or persuaded that existing and newly-identified needs and wants may be satisfied by technological products and services.	2.27	0.67
29	Intra-firm adaptability	Capability to disseminate information through: interdepartmental meetings, interdepartmental cooperation, contacts with customers, both internal and external	2.27	0.72
30	Technology parks	A property development designed for a concentration of high tech, science, or research related businesses.	2.27	0.72
31	Technology transfer	Index, mark, sign or gauge as a measure of	2.27	0.76

	indicators	performance		
32	Enforcement of IPRs	Administration through compliance of intellectual property rights	2.24	0.56
33	Technical documentation	Any type of documentation that describes handling, functionality and architecture of a technical product or a product	2.24	0.66
34	Policies and Regulations	Legal instruments and the associated rules that are to be administered	2.18	0.64
35	Joint ventures	An entity formed between two or more parties to undertake economic activity together	2.15	0.62
36	Venture capital	Investment that is used to support new or unusual undertakings; equity, risk or speculative investment capital.	2.13	0.62
37	Technology spin-offs	An entity or organization becomes an independent business and takes assets, intellectual property, technology, and/or existing products from the parent organization.	2.10	0.61
38	Monetary cost of transfer	Price of the conveying	2.03	0.73

Table 8.2: Sustainable Development Factors iteration 2

No	Sustainable Development Factors	Glossary	Mean	St Dev
1	Enabling environment	The expression that encompasses government policies that focus on creating and maintaining an overall macroeconomic environment that brings together suppliers and consumers in an inter-firm co-operation manner	2.76	0.44
2	Economic sustainability	The idea that future generations should have the same or greater access to economic resources as the current generation.	2.73	0.57
3	Security	The state of being or feeling secure; freedom from fear, anxiety, danger, doubt, etc.;	2.70	0.47
4	Access to internet	Ability to go online onto cyberspace	2.67	0.48
5	Public Private Partnerships	Involvement of private enterprise (in the form of management expertise and/or monetary contributions) in the government projects aimed at public benefit	2.64	0.49
6	Technology innovation capability	The capacity to create new things in the field of technology	2.64	0.60
7	Effective internet governance	The development and application by Governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet	2.61	0.50

8	Gross domestic expenditure on R&D as a percentage of GDP	Gross domestic expenditure on scientific research and experimental development (R&D) expressed as a percentage of Gross Domestic Product (GDP)	2.61	0.50
9	Appropriate use of technology	Proper use of the technology	2.61	0.61
10	Monitoring and evaluation	Monitoring refers to an ongoing process of assessing whether the process of planning and implementation is proceeding on target; evaluation, is an assessment of whether the various goals and objectives have been met.	2.61	0.61
11	Research and development	Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications	2.61	0.61
12	Organization strategy	The process of specifying the organization's mission, vision and objectives, developing policies and plans, often in terms of projects and programs, which are designed to achieve these objectives, and then allocating resources to implement the policies and plans and programs	2.59	0.50
13	Investment in technology	laying out money or capital in an enterprise with the expectation of profit in technology	2.58	0.50
14	Linkages with local firms	Source companies having a connection to local companies	2.58	0.66
15	Adaptation of technology to local environment	Modification of the technology to fit local surroundings	2.55	0.62
16	Availability of basic ICT tools	Accessibility of simple technologies for gathering, storing, retrieving, processing, analyzing and transmitting information	2.52	0.67
17	Availability of skilled workforce	Access to workers who have a pre-set amount of knowledge	2.52	0.67
18	Percentage of population with access to primary health care facilities	Proportion of population with access to primary health care facilities, i.e., essential health care made accessible at a cost the country and community can afford, with methods that are practical, scientifically sound and socially acceptable	2.52	0.67
19	Stakeholder participation	Partners involved in the decision process	2.52	0.67
20	Availability of funds	Money being available	2.48	0.67
21	Trade and investment policies	Legal instruments related to trade and investment	2.48	0.67
22	Social sustainability	The idea that future generations should have the same or greater access to social resources as the current generation.	2.48	0.71

23	Performance measurements	Process whereby established the parameters within which programs, investments, and acquisitions are reaching the desired results	2.45	0.51
24	Choice of technology	Selection of practical sciences to industry, including technical skills , methods and knowledge	2.45	0.62
25	Intellectual Property safeguards	Protection of creations inventions, artistic expressions and other products of the imagination	2.45	0.62
26	Investment policy	A document that formalizes an institution's guidelines for investment and asset management.	2.45	0.62
27	Internet users per population	Internet users are those who use the Internet (World Wide Web) from any location	2.45	0.71
28	Adult literacy rate	The proportion of the adult population aged 15 years and over that has the ability to identify, understand, interpret, create, communicate, compute and use printed and written materials associated with varying contexts	2.45	0.75
29	Storage of content	Information stored on a database	2.42	0.66
30	Adult secondary (tertiary) schooling attainment level	The proportion of the population of working age (25-64 years) which has completed at least (upper) secondary education	2.42	0.75
31	Nature of technology	Type of material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques	2.39	0.50
32	Decision-making process	An outcome of mental processes cognitive process leading to the selection of a course of action among several alternatives	2.39	0.70
33	Production of technology	Processes and methods employed in transformation of tangible inputs (raw materials, semi-finished goods, or subassemblies) and intangible inputs (ideas, information, know how) into goods or services in technology	2.39	0.70
34	Promotion of innovation	Advancement of new ideas	2.36	0.60
35	Replicability of technology	Ability to copy the technology	2.36	0.65
36	Start-up finance	Money provided to "kick-start" a technology project	2.36	0.65
37	Investment share in GDP	The share of investment in relation to total production.	2.36	0.70
38	Gross Domestic Product (GDP) per capita	The total market value of all final goods and services produced in a country in a given year.	2.36	0.74
39	Liberalization policies	Removal of or reduction in the practices that thwart free flow of goods and/or services from one nation to another.	2.36	0.74

40	Innovative culture	A habit of creating something new	2.33	0.69
41	Technology grants	Sum of money provide for specific project in technology	2.30	0.59
42	Alignment of interest between source and recipient	Giver and end-user of technology having the same concern and/or objectives	2.29	0.64
43	Patent protectionism	Protection of the legal rights associated with creations and inventions	2.27	0.63
44	Transparency	Lack of hidden agendas and conditions, accompanied by the availability of full information required for collaboration, cooperation, and collective decision making.	2.27	0.63
45	Ability to share information	Capacity to transmit information and use it in common	2.27	0.67
46	Attraction of FDI	Inflow of investment of foreign assets into domestic structures, equipment, and organizations.	2.27	0.67
47	Cost of communication	Price of transferring information from one entity to another	2.27	0.72
48	ICT Policies and Regulations	Information Communication Technology legal instruments and the associated rules that are to be administered	2.24	0.61
49	Incentive culture	Factors (financial or non-financial) that enables or motivates a particular course of action in the set of shared attitudes, values, goals, and practices that characterizes an institution, organization or group.	2.24	0.61
50	Tax incentives	A stimulus package in terms of taxes for technology investment	2.24	0.61
51	Inflation Rate	The indicator is defined as the annual percentage increase of the consumer price index	2.19	0.65
52	Technology loans	Borrowed money for project(s) in technology	2.12	0.65
53	Unemployment	Having no work	1.91	0.72
54	Monopoly	When a specific individual or an enterprise has sufficient control over a particular product or service to determine significantly the terms on which other individuals shall have access to it	1.67	0.74

Table 8.3: Capacity Building Factors iteration 2

No	Capacity Building Factors	Glossary	Mean	St Dev
1	Availability of resources	Accessible of personnel and major items of equipment, supplies, and facilities that are available for assignment to incident operations	2.76	0.44
2	Training of end users of technology	Educating the recipients who will be users of the technology	2.76	0.44

3	Training of technical staff	Educating the implementers of the technology	2.76	0.44
4	Readiness for absorption of technology	Being ready for technology integration of change and innovation into an organization's culture and operations	2.73	0.45
5	Incentives for new technologies	Stimulation for the creation of new ideas and things	2.70	0.47
6	Monitoring and evaluation	Monitoring refers to an ongoing process of assessing whether the process of planning and implementation is proceeding on target; evaluation, is an assessment of whether the various goals and objectives have been met.	2.70	0.47
7	Support for capacity building institutions	Assistance to entities that do the following: Human resources development/training, Education/building awareness, Institutional strengthening, including local participation	2.70	0.47
8	Training	Educating	2.67	0.65
9	Building awareness	Sensitization of the recipients and community	2.66	0.48
10	Knowledge transfer	Transfer of skills acquired by a person through experience or education and what is known in a particular field or in total	2.64	0.60
11	Promotion of business alliances	Advancing business collaboration	2.61	0.50
12	Infrastructure services	Services offered to physical structures hosting transferred technologies	2.61	0.66
13	Higher Learning Institution curricula matching transfer needs	Content of the course of study in Universities and Colleges	2.59	0.61
14	Collaboration and networking	Working together and inter-connecting with other people and entities	2.58	0.50
15	Locally adapted	Changed to suit local environment	2.58	0.61
16	Technology innovation	Creating new things in the field of technology	2.58	0.61
17	Policies and Regulations	Legal instruments and the associated rules that are to be administered	2.55	0.51
18	Communication skills	Having interpersonal, oral and written communication including the ability to explain complex and or technical information using clear and simple language	2.55	0.62
19	Nurturing knowledge-based development	Cultivating information-based development	2.55	0.62
20	Appropriate investments	Proper expenditure in technology	2.52	0.62
21	Dynamic private sector	An active private sector	2.52	0.62
22	Technology cooperation	Collaboration to create new things in the field of technology	2.52	0.62
23	Locally appropriate	Suited to be used in the local environment	2.52	0.67

24	Applying know-how	Using the expert skills, information, or body of knowledge that (1) imparts an ability to cause a desired result, (2) is not readily available, and is (3) outside the public domain, that can be transferred	2.48	0.67
25	User needs	Requirements of recipients	2.48	0.71
26	Change management	The process during which the changes of a system are implemented in a controlled manner by following a pre-defined framework/model with, to some extent, reasonable modifications	2.45	0.56
27	Ease of understanding the tools	Understanding the tools in technology with simplicity	2.45	0.56
28	Leadership	Ability to command and lead others	2.45	0.56
29	Nature of technology	Type of material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques	2.45	0.56
30	Policies for competitive market	Legal instruments for a market where no entity has the power to affect the market price of a good	2.45	0.62
31	Language	Specialized vocabulary used in communication	2.45	0.71
32	Ability to assess performance	Capacity to measure the results of programs and investments	2.42	0.66
33	Evaluation of technology	Evaluation of practical sciences to industry, including technical skills , methods and knowledge	2.42	0.66
34	International linkages (networking)	Source companies having a connection to international companies	2.42	0.71
35	Incentive culture	Factors (financial or non-financial) that enables or motivates a particular course of action in the set of shared attitudes, values, goals, and practices that characterizes an institution, organization or group	2.37	0.49
36	Social acceptance of technology	To tolerate, differences and diversity among recipients of the technology	2.36	0.65
37	Interaction between researchers and commercial people	A relationship involving those doing scientific studies and business people	2.36	0.70
38	Ability to assess financial performance targets	Capacity to measure the financial parameters of programs	2.33	0.60
39	Post analysis of transferred technology	Evaluating conditions after to technology transfer	2.33	0.60
40	Recipient attitude to technology	Opinion of receiver's to the technology	2.30	0.77
41	Ability to negotiate	Ability to bargain	2.27	0.57
42	Technology gap assessment	Evaluation the difference between those who have technology and high-tech devices in general and those who do not	2.27	0.63

43	Third party institution support of transferred technology	For transferred technology, assistance coming from neither the source nor the recipient	2.18	0.64
44	Brain drain	Depletion or loss of intellectual and technical personnel	1.97	0.73

5.3 Third Delphi survey with SMEs

Understanding the relation between technology transfer/diffusion, sustainable development and capacity building propelled by ICTs is not a straight-forward matter taking into account the cultural norms in the environment. In this case the survey questionnaire was designed to get an understanding and views of ICT SMEs in Rwanda and Tanzania, on their perceived barriers to technology transfer/diffusion. Although the respective influences of each of these factors may not be mutually exclusive, however, the impacts may be push-pulled by cultural, technological and institutional challenges at the macro level in least developing economies seeking to adopt and diffuse efficient and sustainable technologies with their SMES as a priority in getting support. A questionnaire containing factors on technology transfer/diffusion, sustainable development and capacity building from the second delphi study was administered to the recipients. Of the more than 40 factors that were identified in the previous Delphi studies, the highest ranked 10 factors were identified for this third iteration Delphi process. Forty (40) respondents were selected from SME incubated companies in both Rwanda and Tanzania and 20 responded. The respondents were mostly ICT startups and companies in the informal sector and the formal sector, all with a reasonable awareness of ICTs[9]. Respondents were asked to rank the respective factors based on their perception and/or experience of technology transfer/diffusion. The following tables (Table 9.1 – for Technology Transfer/Diffusion Factors, Table 9.2 – for Sustainable Development Factors, and Table 9.3 – for Capacity Building Factors.), show, in descending order of importance, the means and standard deviations for the highest 10 factors based on a 4-point scale from 4 (Very Important) to 1 (Least Important).

[9] In each country, the ratio of informal to formal SME respondents was approximately 3 to 1.

Table 9.1: Technology Transfer/Diffusion 'Factors' third survey

No	Technology transfer/diffusion Factors	Mean	St Dev
1	Quality of transferred technology	3.53	2.06
2	Technology incubators for SMEs	3.47	2.00
3	Venture capital	3.43	2.02
4	Having on-site expert and on-line assistance when delivering and supporting technology transfer projects to SMEs	3.40	1.99
5	Delivery of technology and systems	3.30	1.57
6	Technology marketing ability of SME	3.30	1.78
7	Commercialization of SME technology products	3.27	1.53
8	Conducive policies and regulations affecting SMEs	3.27	1.74
9	Knowledge of opportunities by SMEs	3.20	1.69
10	Risk analysis of transfer	3.20	1.69

Table 9.2: Sustainable Development 'Factors' third survey

No	Sustainable Development Factors	Mean	St Dev
1	Start-up finance for SMEs	3.91	0.29
2	Innovative culture in SME community	3.60	0.89
3	Research and Development in SME environment	3.57	0.68
4	Investment in technology	3.53	0.78
5	Technology loans for SMEs working in the idea and innovation space	3.47	0.90
6	Gross domestic expenditure on R&D as a percentage of GDP	3.43	0.86
7	Organization strategy of SME	3.40	0.77
8	Adaptation of technology to local environment	3.40	0.77
9	Patent protectionism	3.33	0.88
10	Availability of skilled workforce	3.33	0.88

Table 9.3: Capacity Building 'Factors' third survey

No	Capacity Building Factors	Mean	St Dev
1	User needs	3.53	1.14
2	Incentives for new technologies	3.40	1.30
3	Support for capacity building institutions	3.40	1.35
4	Ability to assess financial performance targets	3.33	0.71
5	Training of end users of technology	3.27	0.91
6	Higher Learning Institution curricula matching transfer needs	3.27	0.98
7	Applying know-how	3.27	1.48
8	Building awareness in technology	3.17	1.09

9	Training	3.13	0.22
10	Formal learning as a tool for competence and growth of the SME	3.13	1.20

5.4 Correlation with SPSS

Figure 27 below describes the perceived relationship of the three sectors, technology transfer, capacity building and sustainable development factors that need to be ascertained.

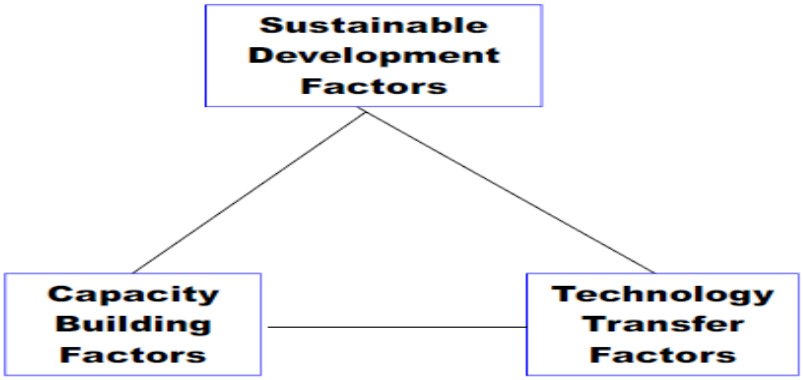


Figure 27: Relationship between Capacity Building, Technology Transfer and Sustainable Development factors
Source: A case study on technology transfer, capacity building and sustainable Development (Amadi-Echendu and Mulamula, 2010)

The triangular relationship that may exist between technology transfer, capacity building and sustainable development could be considered as a triple helix linkage that represents the heart of knowledge-based development that stimulates ideas and policies across from one point to another. As development is transmogrified it becomes possible to stimulate knowledge-based strategy and speed the rate of socio-economic development in a sustainable manner. Understanding these dynamic relationship and interplay is important and the first step to creating the necessary and sufficient conditions for innovation, ICT usage, technology transfer and sustainable development.

To get an understanding of the linkages, the five highest ranked capacity building (CB), technology transfer (TT) and sustainable development (SD) are then used to find if there is any correlation among them. The respondent scores are shown in the following Table 10.

Table 10: 4 point Likert scale of 5 highest ranked CB, SD and TT Factors

Respondent	4 point Likert scale of 5 highest ranked CB, SD and TT Factors														
	CB1	CB2	CB3	CB4	CB5	SD1	SD2	SD3	SD4	SD5	TT1	TT2	TT3	TT4	TT5
1	3	4	3	4	4	3	3	3	4	3	3	2	3	2	3
2	3	3	4	3	2	3	3	3	4	3	3	3	4	3	3
3	3	3	3	3	2	2	3	4	2	4	3	2	4	2	3
4	3	3	3	3	4	3	2	2	3	3	3	3	1	3	3
5	4	4	4	2	3	4	3	4	3	4	4	3	3	4	3
6	3	3	4	3	4	2	4	3	4	3	3	3	4	3	3
7	4	2	4	4	2	4	3	4	4	3	4	3	3	3	3
8	3	3	3	3	3	2	3	3	2	4	3	2	3	2	2
9	2	4	1	1	3	3	2	1	1	2	2	3	1	1	2
10	3	3	3	3	3	4	1	3	3	2	3	3	4	2	3
11	4	4	3	4	2	4	4	3	3	4	4	4	3	4	3
12	2	2	3	3	2	3	3	2	2	1	3	2	2	1	2
13	2	3	1	1	4	2	2	1	1	3	2	2	2	2	2
14	4	4	2	3	2	4	2	2	2	3	3	4	2	3	4
15	3	3	2	3	3	3	1	3	2	2	3	3	3	2	3
16	4	4	3	3	2	4	4	3	4	3	4	4	3	4	4
17	3	3	2	3	3	3	3	2	2	1	3	3	1	2	3
18	4	4	3	4	2	3	3	3	3	3	4	3	2	4	3
19	2	2	2	1	3	2	1	1	2	2	2	1	2	1	2
20	3	3	3	4	3	4	1	2	3	3	3	2	2	2	4

A re-calculation of the mean and standard deviation is performed using SPSS. Table 11 (Technology Transfer/Diffusion five highest ranked factors), Table 12 (Sustainable Development five highest ranked factors) and Table 13 (Capacity Building five highest ranked factors) below show the results of the calculation.

Table 11: Technology Transfer/Diffusion five highest ranked factors

No	Technology transfer/diffusion Factors	Mean	St Dev
TT1	Technology incubators for SMEs	3.10	.641
TT2	Conducive policies and regulations affecting	2.75	.786

	SMEs		
TT3	Having on-site expert and on-line assistance when delivering and supporting technology transfer projects to SMEs	2.60	.995
TT4	Knowledge of opportunities by SMEs	2.50	1.000
TT5	Commercialization of SME technology products	2.75	.550

Table 12: Sustainable Development five highest ranked factors

No	Sustainable Development Factors	Mean	St Dev
SD1	Adaptation of technology to local environment	3.05	.759
SD2	Innovative culture in SME community	2.55	.999
SD3	Availability of skilled workforce	2.60	.940
SD4	Technology loans for SMEs working in the idea and innovation space	2.70	.979
SD5	Patent protectionism	2.80	.894

Table 13: Capacity Building five highest ranked factors

No	Capacity Building Factors	Mean	St Dev
CB1	Training of end users of technology	3.10	.718
CB2	Incentives for new technologies	3.20	.696
CB3	User needs	2.80	.894
CB4	Applying know-how	2.90	.968
CB5	Support for capacity building institutions	2.75	.851

5.4.1 Testing for reliability using SPSS

A measure for reliability is the Cronbach's alpha. In a Lickert scale, Cronbach's alpha is most commonly used to assess the internal consistency of the questionnaire (or survey). If the true score is not measured and there is an error component, the Alpha score is close to zero. Alpha equals 1.0 when all items measure only the true score and there is no error component. Table 14 shows the Chronbach's alpha reliability statistics of the CB, TT and SD factors total scores.

Table 14: Chronbach's alpha reliability statistics of the CB, TT and SD factors total scores

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.880	.881	15

A Chronbach's alpha (α) that is greater than 0.7 indicates a high internal consistency. In this case, α = .880 which indicates the data from questionnaire is reliable. Table 15 shows the item-total statistics of the CB, TT and SD factors.

Table 15: Item-total statistics of the CB, TT and SD factors

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation (*r*)	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
CB1 Training of End Users of Technology	39.05	52.471	.829	.978	.862
CB2 Incentives for New Technologies	38.95	57.524	.341	.788	.880
CB3 User Needs	39.35	51.503	.725	.901	.864
CB4 Applying Know-how	39.25	52.197	.606	.948	.869
CB5 Support of Capacity Building Institutions	39.40	65.095	-.307	.766	.907
SD1 Adaptation of Technology to Local Environment	39.10	56.095	.434	.932	.877
SD2 Innovative culture in SME Community	39.60	52.884	.532	.756	.873
SD3 Availability of Skilled Workforce	39.55	50.261	.785	.983	.860
SD4 Technology loans for SMEs in Innovation working Ideas & Innovation	39.45	50.261	.749	.906	.862
SD5 Patent protection	39.35	53.924	.524	.802	.873
TT1 Technology Incubators for SMEs	39.05	53.208	.855	.989	.863
TT2 Conducive Policies & Regulations affecting SMEs	39.40	54.989	.514	.901	.874
TT3 Having On-site Expert & Assistance Support with Tech Transfer to SMEs	39.55	53.945	.457	.915	.877
TT4 Knowledge of Opportunities by SMEs	39.65	49.082	.823	.991	.858
TT5 Commercialization of SME Tech Products	39.40	58.463	.338	.922	.880

The Item-total statistics of the CB, TT and SD factors table (Table 15) helps to decide whether any items need to be discarded to enhance the chronbach's alpha score. There are two columns of interest: First, the *Corrected Item - Total Correlation* column tells how much each item is linked to the overall questionnaire score. Correlations with r less than or equal to .30, indicate that the item may not belong on the scale. " CB5 Support of Capacity Building Institutions" is the only item (factor) that looks problematic considering this criterion.

Second, and more importantly is the final column in the table *Cronbach's Alpha if Item Deleted*. This column gives the Chronbach's alpha reliability statistics of the total scores one would get if removed from the questionnaire. If this score goes down if one deleted an item, then it is to be kept and if this score goes up after the item is deleted, then it could be deleted to make the questionnaire more reliable. In this case, deleting " CB5 Support of Capacity Building Institutions" would increase the Chronbach's alpha reliability statistics of the total scores to $\alpha = 0.907$ up from 0.880 so deletion should be considered. Tables 16 shows the Chronbach's alpha reliability statistics of the total scores without the "CB5 Support of Capacity Building Institutions".

Table 16: Chronbach's alpha reliability statistics of the CB, TT and SD factors total scores minus CB5 factor

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.907	.908	14

5.4.2 Testing for normality

There are two main methods of assessing normality: numerically and graphically (Ghashemi and Zahediasl 2012). The approaches can be grouped into two main themes: dependence on statistical tests or visual inspection. Statistical tests have the advantage of making an objective judgment of normality, but at times not sensitive enough to low sample sizes or greatly sensitive to large sample sizes. In this study the sample size is small, a size of 20 respondents. As such, in this study a subjective judgment about the data from graphs/plots is also done. Graphical interpretation has the advantage of allowing good judgment to assess normality in situations when numerical tests might be sensitive. Numerically, the main tests used for the assessment of normality are Kolmogorov-Smirnov (K-S) test and Shapiro-Wilk test for a sample size less than 50 (Ghashemi and Zahediasl 2012). In the tests mentioned above, the scores of a normal distribution are compared to the sample scores whereby both have the same mean and standard deviation; the null hypothesis is that "sample distribution is normal." If the test is significant, the distribution is non-normal. The Tables 17, 18 and 19 below presents the results from the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test for the CB, TT and SD factor scores.

Table 17: Tests of Normality: Capacity building factors

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CB1 Training of End Users of Technology	.255	20	.001	.812	20	.001
CB2 Incentives for New Technologies	.263	20	.001	.800	20	.001
CB3 User Needs	.288	20	.000	.860	20	.008
CB4 Applying Know-how	.341	20	.000	.785	20	.001
CB5 Support of Capacity Building Institutions	.216	20	.016	.874	20	.014

a. Lilliefors Significance Correction

Table 18: Tests of Normality: Technology transfer factors

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TT1 Technology Incubators for SMEs	.312	20	.000	.788	20	.001
TT2 Conducive Policies & Regulations affecting SMEs	.275	20	.000	.864	20	.009
TT3 Having On-site Expert & Assistance Support with Tech Transfer to SMEs	.206	20	.026	.888	20	.025
TT4 Knowledge of Opportunities by SMEs	.241	20	.003	.879	20	.017
TT5 Commercialization of SME Tech Products	.375	20	.000	.720	20	.000

a. Lilliefors Significance Correction

Table 19: Tests of Normality Sustainable development factors

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SD1 Adaptation of Technology to Local Environment	.226	20	.009	.816	20	.002
SD2 Innovative culture in SME Community	.274	20	.000	.863	20	.009
SD3 Availability of Skilled Workforce	.265	20	.001	.876	20	.015
SD4 Technology loans for SMEs in Innovation working Ideas & Innovation	.213	20	.018	.879	20	.017
SD5 Patent protection	.288	20	.000	.860	20	.008

a. Lilliefors Significance Correction

5.4.3 Understanding the Shapiro-Wilk Sig values

In the test for normality, the null hypothesis is that the sample values are got from a population considered to be in a normal distribution – the nil hypothesis indicating there is no difference between observed numbers and expected normally distributed numbers. The p-

value (Sig value) is an approximation of the probability that a random sample would generate data that diverge from the normal distribution as much as the observed data do. That probability is calculated assuming that the null hypothesis is true. However, when the sample size is small, the p-values in the Tests of Normality tables in SPSS can be misleading (StatisticalMisses 2016). From the above tables (Tables 17, 18 and 19), in the Sig column of the Shapiro-Wilk column, the values are less than 0.05 indicating the data significantly deviates from a normal distribution. With the Shapiro-Wilk test, a small sample might by chance look non normal. The question is whether the data are close enough to the normal distribution to allow the use of conventional statistical tests. Unfortunately the results from the normality tests from Tables 17, 18 and 19 do not answer this question. The inclination is to reject the null hypothesis that the data was got from a normally distributed population. However, if the null is rejected, the validity of normality assumption cannot be confirmed through the conducted test and so another test is considered, which is the skewness and kurtosis approach.

5.4.4 Using skewness and kurtosis statistics to interpret normality

One can calculate summary statistics that measure skewness and kurtosis z-values. For both measures, a perfectly normal distribution should return a score of 0. Otherwise: A positive (right) skew is indicated by a positive skewness value; a negative value indicates negative (left) skew. The higher the absolute value, the greater the skew. Similarly, a positive kurtosis value indicates positive kurtosis; a negative one indicates negative kurtosis. The higher the absolute value, the greater the kurtosis. SPSS reports a statistic called the standard error for both the skewness and kurtosis scores. If either score is divide by its standard error and the result is greater than -1.96 and +1.96, it suggests that the data are not normal with respect to that statistic. Table 20 shows the skewness and kurtosis descriptive for each factor and the associated value after division by its standard error.

Table 20: Skewness and kurtosis descriptive

		Statistic	Std. Error	Divided vales
CB1 Training of End Users of Technology	Skewness	-.152	.512	-0.297
	Kurtosis	-.880	.992	-0.887
CB2 Incentives for New Technologies	Skewness	-.292	.512	-0.570
	Kurtosis	-.734	.992	-0.740
CB3 User Needs	Skewness	-.549	.512	-1.072
	Kurtosis	-.046	.992	-0.046
CB4 Applying Know-how	Skewness	-.944	.512	-1.844
	Kurtosis	.335	.992	0.338
TT1 Technology Incubators for SMEs	Skewness	-.080	.512	-0.156

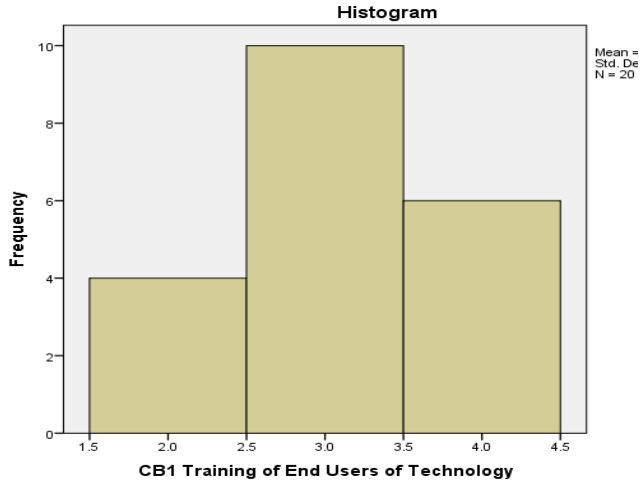
	Kurtosis	-.250	.992	-0.252
TT2 Conducive Policies & Regulations affecting SMEs	Skewness	-.225	.512	-0.439
	Kurtosis	-.018	.992	-0.018
TT3 Having On-site Expert & Assistance Support with Tech Transfer to SMEs	Skewness	-.128	.512	-0.250
	Kurtosis	-.884	.992	-0.891
TT4 Knowledge of Opportunities by SMEs	Skewness	.175	.512	0.342
	Kurtosis	-.921	.992	-0.928
TT5 Commercialization of SME Tech Products	Skewness	-.132	.512	-0.258
	Kurtosis	-.076	.992	-0.077
SD1 Adaptation of Technology to Local Environment	Skewness	-.086	.512	-0.168
	Kurtosis	-1.154	.992	-0.163
SD2 Innovative culture in SME Community	Skewness	-.328	.512	-0.641
	Kurtosis	-.846	.992	-0.853
SD3 Availability of Skilled Workforce	Skewness	-.321	.512	-0.627
	Kurtosis	-.577	.992	-0.582
SD4 Technology loans for SMEs in Innovation working Ideas & Innovation	Skewness	-.067	.512	-0.131
	Kurtosis	-.964	.992	-0.972
SD5 Patent protection	Skewness	-.549	.512	-1.072
	Kurtosis	-.046	.992	-0.046

All values are well within -1.96 and +1.96 limits, suggesting that the data does not seem to differ significantly from normality though having a negative skew. It can be assumed the data is approximately normally distributed in terms of skewness and kurtosis. This is confirmed by visual inspection of the histogram and scatter plots (Q-Q plots) of the same data shown below.

5.5.5 Graph analysis: histograms and scatter (Q-Q) plots for the factors

To get a visual perspective of whether a distribution is bell shaped, a frequency distribution that plots the observed values can be done. In order to determine normality graphically, histograms and the output of a normal Q-Q Plot can be used. If the data are normally distributed, the histogram has a bell shape and the data points in the Q-Q plot will be close to the diagonal line. If the data points drift from the line in an obvious non-linear fashion, the data are not normally distributed. The same data from the same items can be analyzed to produce a Normal Q-Q Plot as below. From this graph, we can conclude that the data appears to be normally distributed as it follows the diagonal line closely and does not appear to have a non-linear pattern. The following figures (28a – 28n) show the histograms and associated Q-Q plots.

Figure 28a: CB1 Training of End Users of Technology



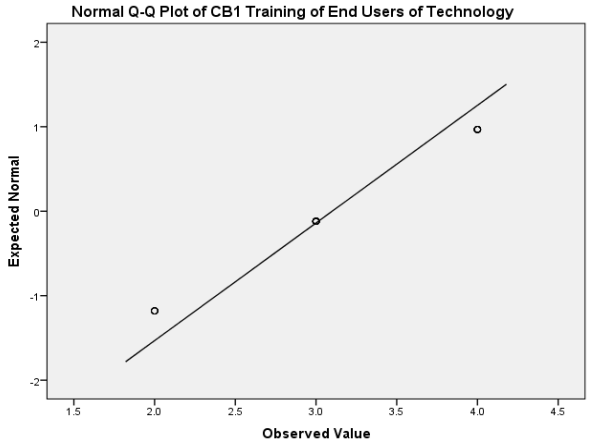
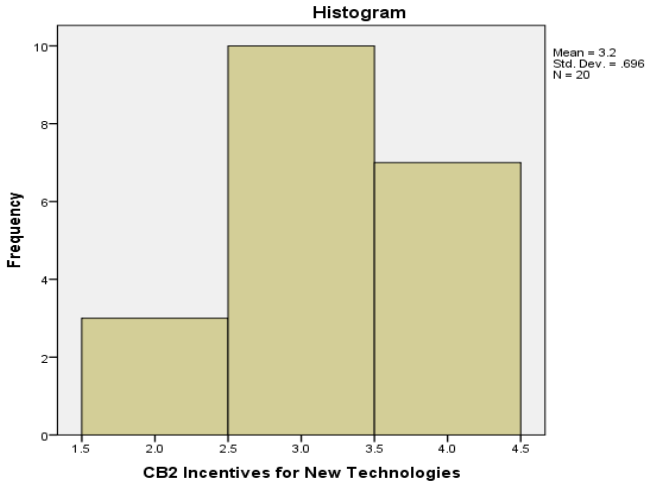


Figure 28b: CB2 Incentives for New Technologies



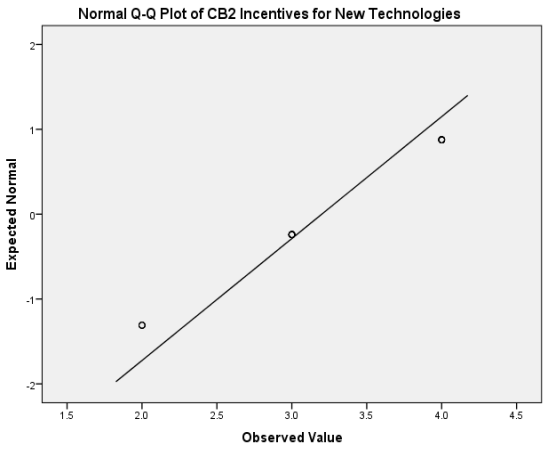
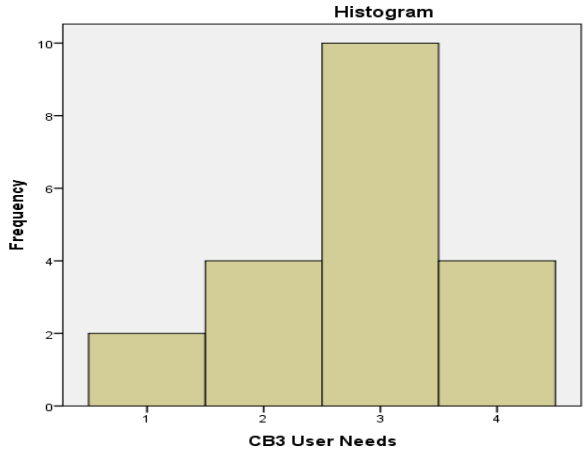


Figure 28c: CB3 User Needs



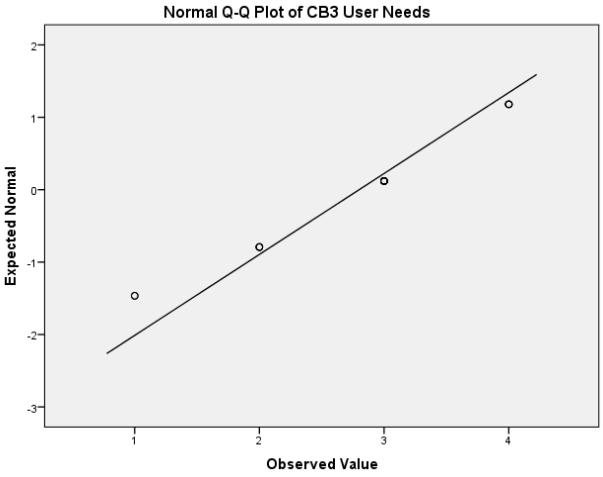
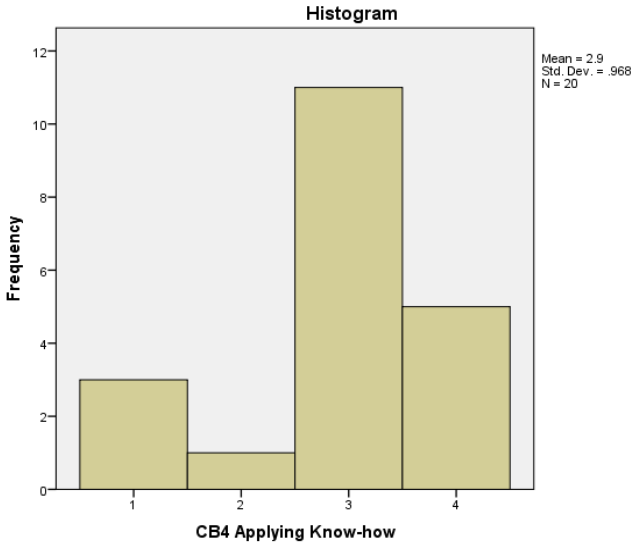


Figure 28d: CB4 Applying Know-how



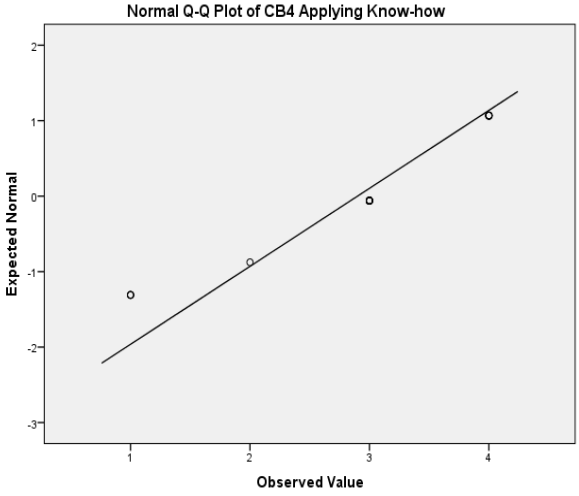


Figure 28e: TT1 Technology Incubators for SMEs

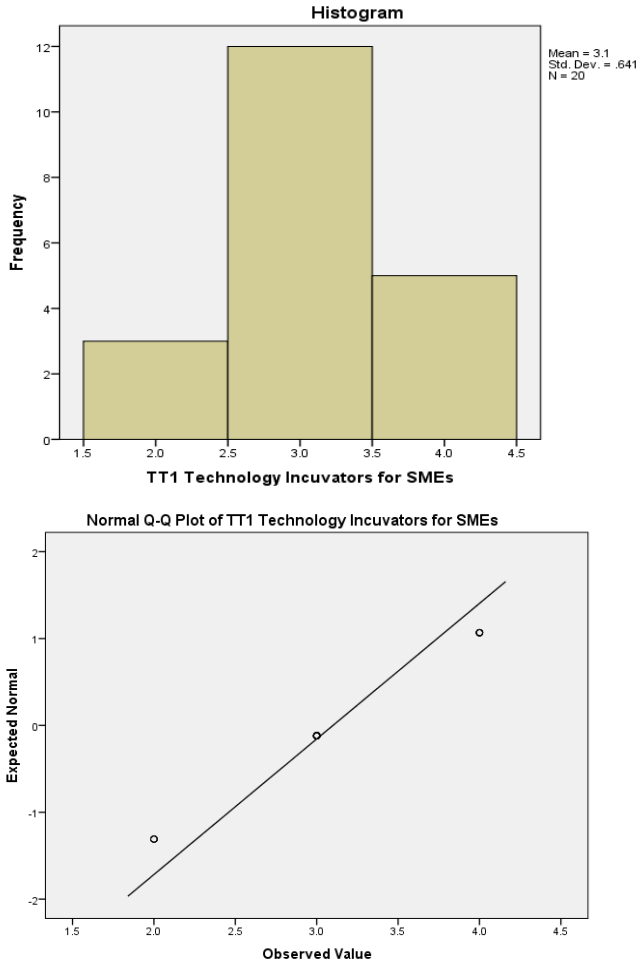


Figure 28f: TT2 Conducive Policies & Regulations affecting SMEs

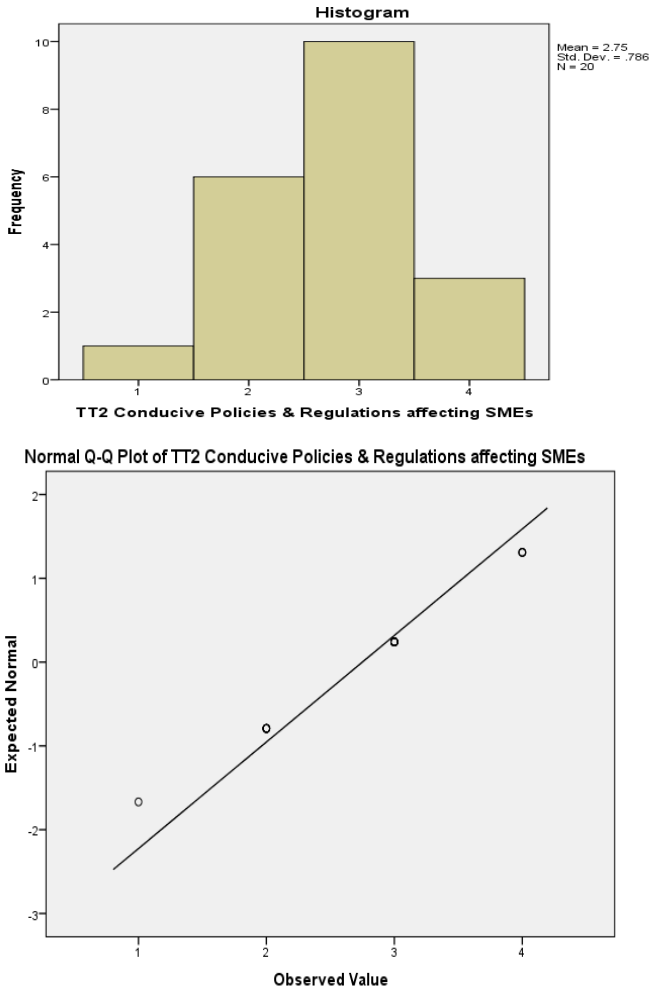
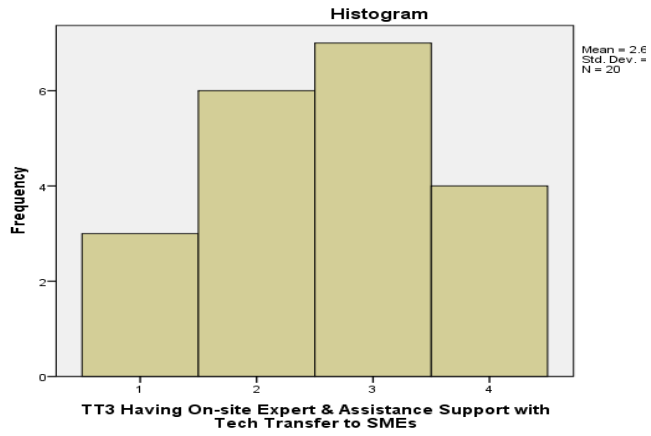


Figure 28g: TT3 Having On-site Expert & Assistance Support with Tech Transfer to SMEs



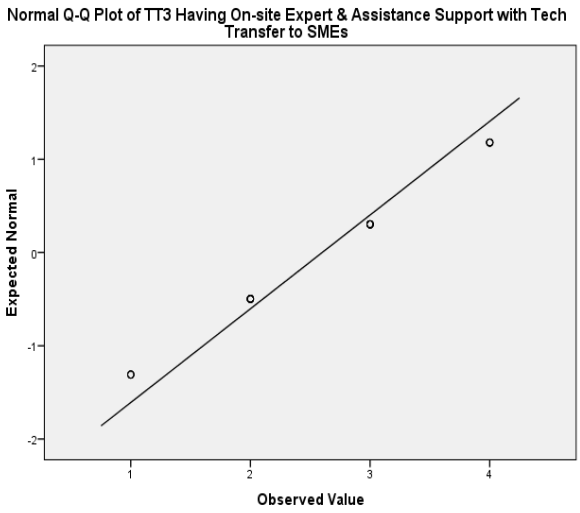
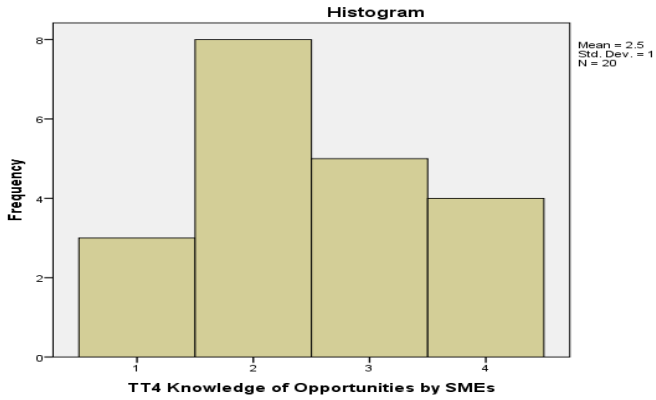


Figure 28h: TT4 Knowledge of Opportunities by SMEs



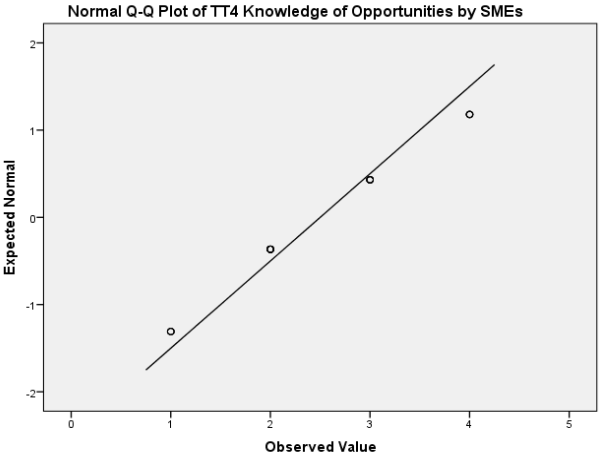


Figure 28i: TT5 Commercialization of SME Tech Products

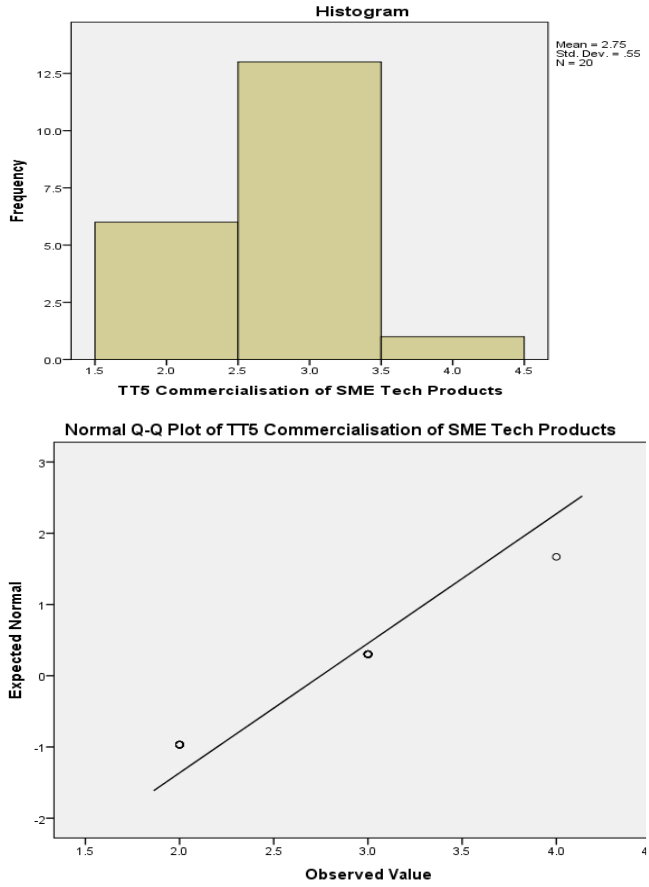


Figure 28j: SD1 Adaptation of Technology to Local Environment

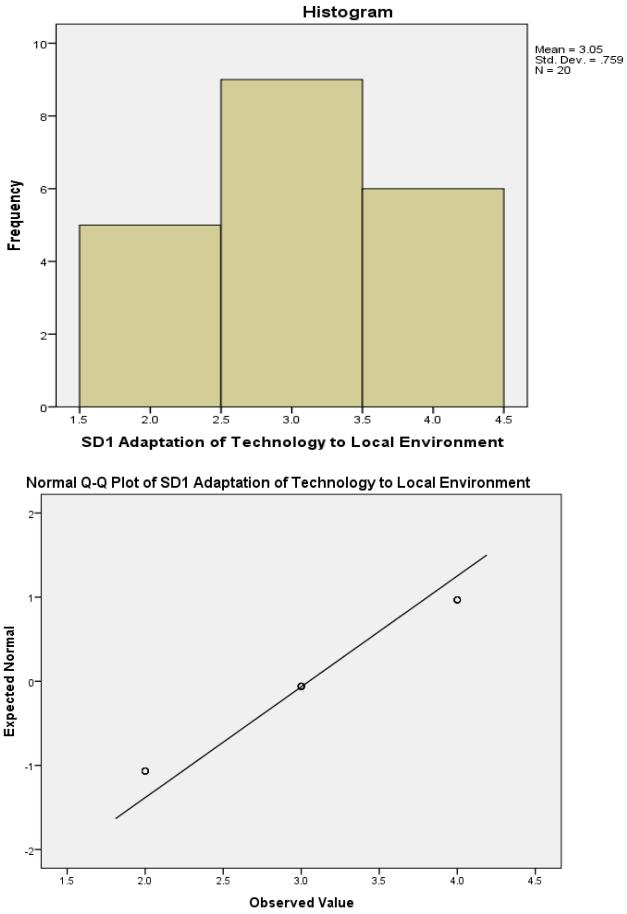


Figure 28k: SD2 Innovative culture in SME Community

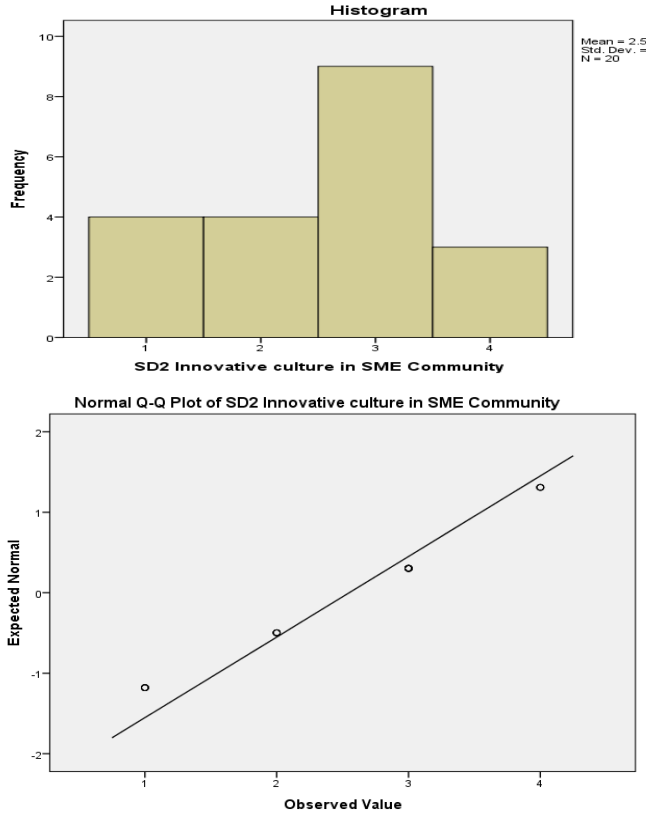


Figure 28l: SD3 Availability of Skilled Workforce

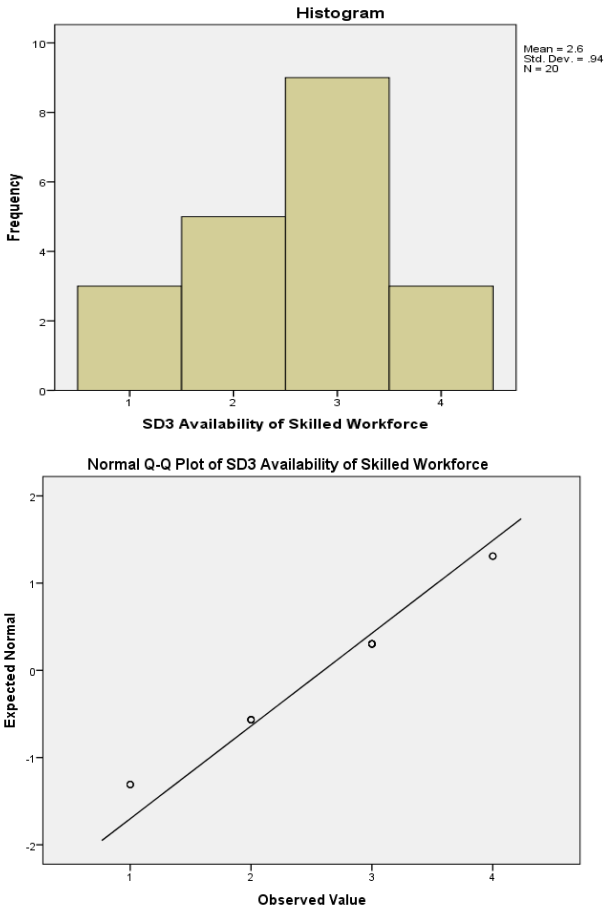


Figure 28m: SD4 Technology loans for SMEs in Innovation working Ideas & Innovation

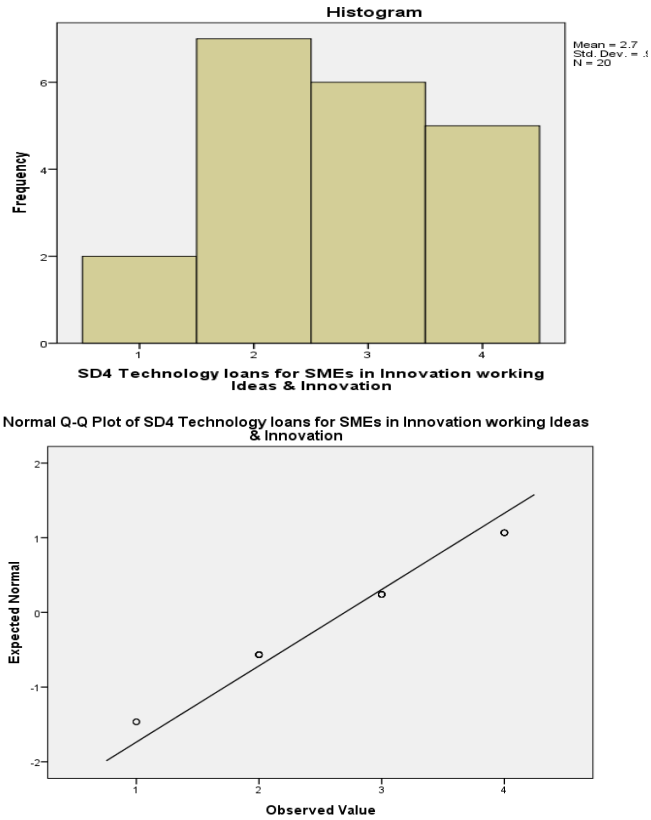
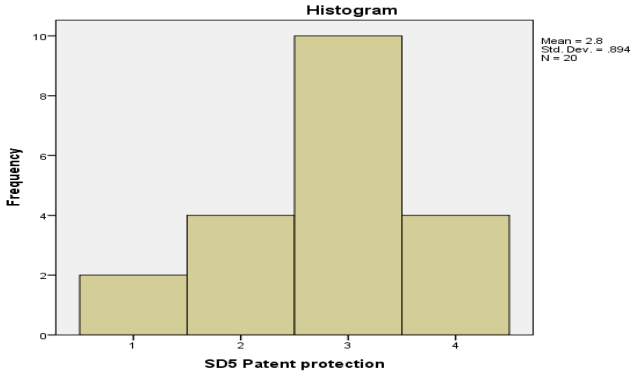
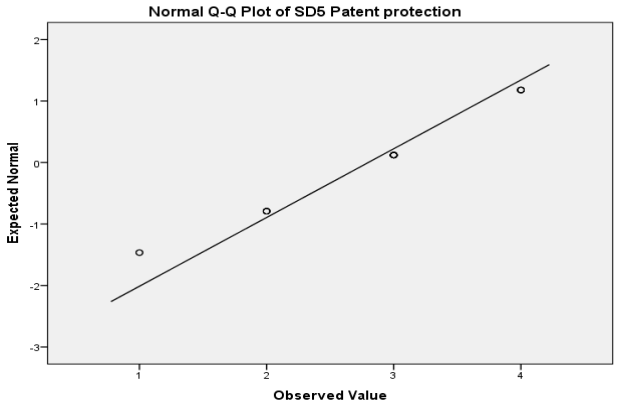


Figure 28n: SD5 Patent protection





The histograms seem to have an approximate shape of the normal curve and their associated Q-Q plots have dots that tend to be along the diagonal line. This indicates the data are approximately normally distributed.

5.5.6 Correlation analysis

Correlation is a statistic used for measuring the strength between two variables and how they fluctuate together. The most common correlation coefficient is the pearson correlation coefficient. The test statistics called the correlation coefficient (pearson correlation coefficient (r)) measure the strength between the variables. This measure varies from 0 (no relationship) to -1 and to +1 (perfect relationship). The strength of the relationship (minus or plus) is assumed to be:

0.0 : Zero (none)

0.1 – 0.399: Weak

0.4 – 0.699: Moderate

0.7 – 0.999: Strong

1.0 : Perfect

Table 21 (Capacity building vs Technology transfer factors), Table 22 (Technology transfer vs Sustainable development factors) and Table 23 (Capacity building vs Sustainable development factors), show the results of doing a correlation analysis of the capacity building, technology transfer and sustainable development factors.

Table 21: Correlation - Capacity building vs Technology transfer factors (CB vs TT)

		TT1 Technology Incubators for SMEs	TT2 Conducive Policies & Regulations affecting SMEs	TT3 Having On-site Expert & Assistance Support with Tech Transfer to SMEs	TT4 Knowledge of Opportunities by SMEs	TT5 Commercialization of SME Tech Products
CB1 Training of End Users of Technology	Pearson Correlation	.892*	.699*	.280	.879*	.200*
	Sig. (2-tailed)	.000	.001	.232	.000	.398
	N	20	20	20	20	20
CB2 Incentives for New Technologies	Pearson Correlation	.307	.577	-.030*	.529	.000
	Sig. (2-tailed)	.188	.008	.899	.016	1.000
	N	20	20	20	20	20
CB3 User Needs	Pearson Correlation	.680	.150	.615*	.530	.321
	Sig. (2-tailed)	.001	.529	.004	.016	.168
	N	20	20	20	20	20
CB4 Applying Know-how	Pearson Correlation	.696	.311**	.284**	.435	.346**
	Sig. (2-tailed)	.001	.182	.225	.055	.135
	N	20	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 22: Correlation - Technology transfer vs Sustainable development factors (TT vs SD)

		SD1 Adaptation of Technology to Local Environment	SD2 Innovative culture in SME Community	SD3 Availability of Skilled Workforce	SD4 Technology loans for SMEs in Innovation working Ideas & Innovation	SD5 Patent protection
TT1 Technology Incubators for SMEs	Pearson Correlation	.638	.568	.769**	.638	.404
	Sig. (2-tailed)	.002	.009	.000	.002	.077
	N	20	20	20	20	20
TT2 Conducive Policies & Regulations affecting SMEs	Pearson Correlation	.727	.385**	.285	.308	.150**
	Sig. (2-tailed)	.000	.093	.224	.187	.529
	N	20	20	20	20	20
TT3 Having On-site Expert & Assistance Support with Tech Transfer to SMEs	Pearson Correlation	.028	.286	.720	.519	.438
	Sig. (2-tailed)	.907	.221	.000	.019	.054
	N	20	20	20	20	20
TT4 Knowledge of Opportunities by SMEs	Pearson Correlation	.520	.553**	.560**	.592	.588**
	Sig. (2-tailed)	.019	.011	.010	.006	.006
	N	20	20	20	20	20
TT5 Commercialization of SME Tech Products	Pearson Correlation	.032	-.024	.305	.342	.214
	Sig. (2-tailed)	.895	.920	.191	.140	.365
	N	20	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 23: Correlation - Capacity building vs Sustainable development factors (CB vs SD)

		SD1 Adaptation of Technology to Local Environment	SD2 Innovative culture in SME Community	SD3 Availability of Skilled Workforce	SD4 Technology loans for SMEs in Innovation working Ideas & Innovation	SD5 Patent protection
CB1 Training of End Users of Technology	Pearson Correlation	.666*	.433*	.686	.569*	.524*
	Sig. (2-tailed)	.001	.057	.001	.009	.018
	N	20	20	20	20	20
CB2 Incentives for New Technologies	Pearson Correlation	.379	.288	.129*	.093	.406
	Sig. (2-tailed)	.100	.219	.589	.697	.076
	N	20	20	20	20	20
CB3 User Needs	Pearson Correlation	.248	.483	.776*	.830	.408
	Sig. (2-tailed)	.292	.031	.000	.000	.074
	N	20	20	20	20	20
CB4 Applying Know-how	Pearson Correlation	.365	.332**	.590**	.633	.219**
	Sig. (2-tailed)	.113	.153	.006	.003	.354
	N	20	20	20	20	20

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

With regards to the significance value (Sig p) if the value is less than 0.05 ($p < 0.05$) it means there exists a significant relationship between the two associated factors. In Table 21 of CB vs TT factors, there is a strong correlation in these factors: CB1 and TT1; CB1 and TT4. There is a moderate strong correlation in these factors: CB1 and TT2; CB3 and TT1; CB3 and TT3; CB4 and TT1. In Table 22 of TT vs SD factors, there is a strong correlation in these factors: TT1 and SD3, TT2 and SD1, TT3 and SD3. There is a moderate strong correlation in these factors: TT1 and SD1, TT1 and SD4. In Table 23 of CB vs SD factors, there is a strong correlation in these factors: CB3 and SD3, CB3 and SD4. There is a moderate strong correlation in these factors: CB1 and SD1, CB1 and SD3, CB4 and SD4.

Chapter 6 Data Analysis

The analysis tries to highlight if there is a link between ICT transfer and human capital development, whether human capacity development is affected by an increase in ICT transfer and finally if SMEs can have sustainable development through usage of ICTs.

6.1 Presentation and analysis of Delphi study results

In the first Delphi study, a majority of the respondents were interviewed on their understanding of the questionnaire. Their responses indicated an awareness of ICT issues, but lacked exposure to regional and international issues of technology transfer and related matters. This could have influenced how they ranked the factors in the questionnaire. Never-the-less, the study was able to explore the respondents' perceptions on the various factors. Steenhuis et al (2001:560) point that adapting appropriate technologies in a nation, is dependent on the crucial factors in Technology Transfer, Sustainable Development and Capacity Building being realized appropriately. This was highlighted by the respondents when they ranked the factor "understanding local needs" as important. Most respondents felt that infrastructure is important. Also, involving the local community and an enabling environment was important. This is illustrated by Irrgang (2007:4), who surmises technology transfer should be implemented involving both sender the recipient environments. Underwood (2008:15) states that the challenge is to overcome the recipients' environmental constraints, which include lack of ICT infrastructure, unreliable power supplies, illiteracy and mind-sets dealing with change. Respondents may have had this in mind when they ranked the factors related to the adaptation of technology was "the readiness of a recipient community for absorption of technology". In the second Delphi study, the respondents were mainly from the ICT field, with some management people and a few researchers in the science field. All of them were

university graduates, but one had the feeling that their capacity to analyze the various sub-factors was limited. This could be due to lack of exposure to international issues of technology transfer and related matters.

Cognizant of the above, Table 8.1 (Technology Transfer Factors), not all the factors were answered by the respondents. Even though there was a glossary, it could be comprehension of the meaning of the factor was difficult. As an example are the factors: Commercialization of technology (3 missing responses), Technology spin-offs (3 missing responses), and Monetary cost of transfer (4 missing responses). The respondents felt that knowledge and understanding local needs was important. The quality and nature of technology were also a crucial component in the transfer.

For Sustainable Development Factors (Table 8.2), the following factors may have been difficult for the respondents to understand: Enabling environment (4 missing responses), Intellectual Property Safeguards (2 missing responses), Alignment of interest between source and recipient (2 missing responses), and Inflation rate (2 missing responses). The respondents felt that it was paramount to have stability in the economy with an enabling environment. Also important was the ability to perform technological innovation, with an infusion of research and development funding as a percentage of the GDP of the nation. Furthermore, working on a PPP (Public-Private-Partnership) could enhance innovation. Also deemed to be important were: Primary health care access for the population, nature of technology, access to internet, a skilled workforce and R&D funding.

In relation to Capacity Building Factors (Table 8.3), the following factors were not completely answered: Building awareness (1 missing response), Higher Learning Institution curricula matching transfer needs (1 missing response), Incentive culture (3 missing), and Brain drain (4 missing responses). The respondents felt that the availability of resources and training technical staff were crucial. Moreover, to have absorption

capacity of the technology the recipients had to be prepared. Also important was the presence of collaboration efforts among all stakeholders for knowledge transfer and awareness building for the technology transfer.

The third iteration of the Delphi study conducted to further examine the linkages between technology transfer, sustainable development and capacity building with an emphasis on SMEs is shown in Tables 9.1, 9.2 and 9.3. The feedback obtained leads to some interesting observations. Although the data is not statistically robust, however, the variation in the mean values ranging between 3.91 and 3.13, suggests that the Likert scale range may not be sufficiently discriminating. Never-the-less, based on the high means, it indicates that among the technology transfer/diffusion factors, the quality of transferred technology and technology incubation for SMEs are very important issues to be considered. SMEs are seen as a critical part of the private sector and can contribute greatly to economic development. For sustainable development factors, lack of start-up finance for SMEs and low SME innovative culture are barriers given prominence. With regards to capacity building, it is important to pay attention to user needs and incentives for new technologies.

6.2 Significance of case studies

With regards to South Korea, the literature review indicates the country is a world leader in broadband internet access and ranked fifth in overall access to the internet.. It has achieved universal access provision to a majority of the households including telephony service and has one of the world's leading ICT manufacturing sectors. South Koreans are well educated and rank high in literacy and overall educational achievement. The ICT policies and strategies have contributed greatly to the economy of the country. The positive effects of robust government policies were combined with a public-private partnership approach in a free market economy encouraged investments with

competition. Due to this competitive market environment, service providers maintained low tariffs and fees resulting in better broadband internet services.

In India, the small and medium enterprises that have integrated and used appropriate ICT have been able to compete and remain successful to compete in the domestic as well as global markets. Nevertheless, ICT adoption in various sectors and the penetration of ICT in Indian firms is somewhat low. Some of the reasons are: Limited internal IT expertise and managerial knowledge; Very few employees of a typical micro SME gain relevant expertise in IT during their education (largely vocational training); affordable and customized solutions; network Infrastructure; awareness of ICT benefits and language issues; training Issues: Very few Micro SME employees undergo IT training during the course of their employment.

Kenya's Vision 2030 underscores the important role of ICT in economic development in presenting many opportunities for improved market access in the highly globalised knowledge economy. It is expected that greater ICT adoption by Kenyan SMEs across a wide range of industry sectors with innovation should generate more efficiency and productivity and open a number of opportunities. These could be such as gaining wider access to local, regional and global markets, improving communications with prospects and customers. The aim of boosting ICT utilization be supportive of the Vision 2030 goal to develop Kenya into a regional technology hub, and foster a domestic ICT sector with a larger contribution to GDP..

6.3 Significance of Delphi study correlation analysis

The analysis of the data after the correlation of the factors shows that there is a positive correlation between capacity building and information communication technology transfer, information communication technology transfer and sustainable development

and capacity building and sustainable development. The results in Table 21 of capacity building factors in relation to technology transfer factors that are highly rated indicate the following: (a) building capacity by training of end users of the technology would provide the knowledge to take advantage of opportunities that would arise in their activities; (b) Using technology incubators would greatly enhance their absorption capacity; (c) At a moderate level, technology incubators assist in identifying user needs and applying the appropriate knowledge in the application of transferred technology. Results from Table 22 of technology transfer factors in relation to sustainable development factors results give great importance to conducive policies and regulations allowing transferred technology to be adopted to fit the local environment. Also important is to have sustainable development technology incubators and knowledgeable technology transfer experts help build a skilled workforce among the recipients of the technology. At a moderate level, adaptation of the technology to the local environment can be catalyzed by technology incubators with supported funding to have innovation. With regards to Table 23 of capacity building factors in relation to sustainable development factors, a skilled workforce would understand the user needs and the role of funding to scale up the growth of small and medium enterprises. At a moderate level, building the capacity of end users to be a skilled workforce with knowledge, allows the transferred technology to adapted to the local environment.

6.4 Overall significance of results

The results underscore the outcome of the report of the UN Economic and Social Council (2006:8) on the need to have an integrated and sustainable approach to technology transfer and it includes having recipients with the capability for absorption capacity. As much as it is difficult to ascertain whether the respondents were answering based on their experience or their desire for the factors to be part of a “wish list”, the analysis so far indicates there is a positive correlation between capacity building and information

communication technology transfer, information communication technology transfer and sustainable development and capacity building and sustainable development. To have a fast paced integrated and sustainable development growth through technology transfer, leapfrogging can be a crucial process. The potential for leapfrogging with the ability to access a reasonable investment in skills and equipment forms the basis to bypass earlier stages of development. The absorptive capacities to produce or use ICTs are a crucial requirement for technology leapfrogging (Steinmueller 2001: 206). The development of absorptive capacities are affected by the limitations of self-training and education. For example, documentation accompanying the acquiring of absorptive capacities are primarily in the English language (as in the case of India). This does not enhance self-learning for a community that does not have english as their mother tongue nor the ability to understand the language. Another prerequisite for leapfrogging is acquiring know-how to make efficient and strategic use of technology for development (Watson and Sauter 2008:6). Furthermore, the required infrastructure and management capabilities require noteworthy investments.

From a global perspective, investment in ICT can be viewed in seven principles, as illustrated in Figure 29 by Harrison and Huntington (in Government of Jamaica 2007:12).

Social	Culture	• Awareness of importance of ICT in increasing competitiveness • The lack of entrepreneurial and innovative culture limits the number of new ICT businesses created • Lack of recognition in mainstream business culture of ICT benefits for individual players
	Human	• Shortage of trained ICT professionals and skilled entrepreneurs • Institutions of higher learning are graduating increasing numbers of engineers and IT Professionals
	Knowledge	• Wide gaps exist in key domains of ICT expertise: software development; manufacturing capabilities; and design of telecom networks.

	Institutional	• Proactive Government that champions ICT • Weak institutional support for ICT (e.g. there is no professional ICT industry association)
Physical	Financial	• High risk profile and lack of collateral make obtaining financing from local commercial banks for ICT start-ups difficult • Lack of alternative financing sources for technology ventures
	Man-made	• Modern fixed telephone network with fiber optic switches • Wide coverage of cellular telephone networks • Cost, speed and reliability of data connectivity is a key constraint for ICT industry
	Natural Endowments	• Rwanda's landlocked status prevents direct access to undersea fiber connectivity but Tanzania's coast provides the landing and gateway for the land-locked countries

Figure 29: Seven Guiding Principles for Capital
Source: Harrison and Huttington (in Government of Jamaica National Development Policy Document)

The above principles provide a useful framework to define progress under seven components separated among physical (or lower) and social (or higher) forms. There are positive investments that can be made in the ICT Industry, such as a proactive government that champions ICT through investments in e-Government, policy and law-making and institution building. However, while there are a number of achievements, this investment could possibly not create the required sustainable development unless the negative factors are addressed. Possible negative factors include the lack of entrepreneurial and innovative culture that limits the number of new ICT business created as well as limited technical and business skills within the sector. On physical assets, one of the ICT industry key weaknesses is the cost, speed and reliability of data connectivity. The limited number of ICT entrepreneurs (i.e., technopreneurs) is a major challenge. In LDCs, most SMEs that use ICT as a tool for business growth, focus on hardware sales and maintenance.

Chapter 7 Implications of study for Rwanda and Tanzania and conclusion

This study finds that ICT diffusion and intensification of information activities do not lead specifically to economic growth but they are a catalyst for change within economies and small and medium enterprises. Generally organizations are faced with pressures to be disruptive in the way they deliver products and services, and policymakers need to create the enabling environment for the change to occur so that the country benefits. It can be argued that ICT is a prerequisite for the economic development of Rwanda and Tanzania. Making ICT an integral part of the development process in requires upgrading technical capabilities. Similarly, enhancing their capabilities to utilize and elaborate on ICT, requires a strategic mindset reinforced by commitment of the leadership and policymakers in the two countries. Note that, the two countries are part of the East Africa Community, which is striving for regional integration. This is a process where the member states[10] agree collectively to offer preferential trade agreements within themselves by removing tariffs and non-tariff barriers to trade. Regional integration entails putting in place market regulations and that will challenge SMEs wanting to compete in the regional market. Yahya and Mutarubukwa (2015:14) declare that SMEs will have to work across borders in a competitive market. This market has different elements and constraints in the business environment that have to be considered, including: political and macro-economic stability; regulation; availability of skilled labour which is at different levels; access to insurance and finance; infrastructure, lack of up-to-date information; to name a few. These elements and constraints challenge the process and the way technology transfer, and capacity building of SMEs for sustainable development and growth is undertaken. Based on GDP of the member states of EAC, Kenya is seen to be more developed then the rest of the member countries. This means, SMEs in Rwanda and Tanzania will have to leapfrog in the uptake of technology transfer;

[10] Member states are Kenya, Tanzania, Uganda, Burundi, Rwanda and South Sudan

implement knowledge transfer, build capacity and skills that are strategic to enable the SMEs to compete in the region.

Keeping in mind the difficulties or challenges of achieving the necessary technology transfer, the case studies from South Korea, India and Kenya provide insights to good policies and strategies for implementation that can help have sustainable growth and leapfrog to achieve economic development. Therefore, it may not be far-fetched to assume that for SMEs to grow there should be a link between *technology transfer/diffusion*, *s*ustainable *d*evelopment and *c*apacity *b*uilding propelled by ICT usage.

7.1 Implication of information communication technology transfer on capacity building

Overall, the fundamental goal of skills-building is to enhance the ability to evaluate and address crucial questions related to the choice of technology and frameworks for implementation. This is exemplified in the report which mapped best practices in regional and multi-country cooperative of science, technology and innovation (STI) intitiatives between Africa and Europe. The innovation for poverty alleviation in South Africa programme (European Commission, 2013: 123) had the objective of supporting the South African Department of Science and Technology in building capacity through training and implement policies for promoting the application of STI to alleviate poverty by creating jobs and SMEs. The result has been 3,064 persons getting trained, 48 SMEs being create, 859 jobs generated, 46 local government authorities getting and using ICT networks, 1,775 households getting access to water and 410 to electricity. Furthermore, two policy dialogues were held, one on water technologies and another on ICT access and connectiovity to rural communities in South Africa. The debates on the adoption of 'appropriate technology' has highlighted the importance of linking technical innovation to

suit the local environment. In the business literature emphasis has shifted to the need of using ICT to support localized learning, while the cumulative nature of a countries' technological capacity recognized the importance of considering specific national economic conditions when formulating industrial and technological policy, Amable, (in Avgerou 1998:13). ICT-related capabilities is similar to learning a language. For Rwanda and Tanzania, to attain knowledge in ICTs provides a different perspective that can result in a clearer understanding of the capabilities for innovation. It can lead to people restructuring the ways in which they communicate with each other. At the same time, gains from such new tools can never be fully anticipated as it borders on the realm of disruptive technologies. The more the knowledge is acquired, the more the greater the capacity to be visionary and be innovative.

7.2 Implication of information communication technology transfer on sustainable development

A number of facilities and entities to promote technology transfer/diffusion have been established in Rwanda and Tanzania, namely business incubators and innovation hubs. They perform many activities related to business development services, such as information provision, technology demonstration, and access to finance, computers and software. These facilities and entities also aim to improve links that enhance technology transfer to local users. With regards to local developers, support to them is through physical infrastructure, which allows shared access to facilities and equipment, expertise, and skilled employees. To enhance sustainability, among other things incubators provide information search and referral services, training and technical assistance. Information services catalyze the uptake of technology transfer/diffusion locally and this is usually supported by the appropriate training. This training, is conducted in many different ways, from classroom training to study visits to distance learning and on-the job training with start-ups and SMEs. These measures address the tendency of managers and policy makers to under-invest in human capital development and thus hampering sustainable

development. For sustainable development to occur, the policy makers and strategic planners in Rwanda and Tanzania need to understand that the technology has to be *appropriate*: it has to be useful to the local people and in tune with other local aspirations and desires for development. It should be understood, the way in which technological knowledge is processed, communicated, and associated products and services provided, is continuously changing, facilitated by ICTs.

7.3 Implication of incubation and information communication technology transfer on small and medium enterprise development

Rwanda and Tanzania view small and medium enterprises (SMEs) as crucial for their economic growth and have an important role to play in poverty reduction and employment creation. Least developed countries need to accompany ICT innovation with the adoption of economic and organizational forms transferred from the industrialized, states Avgerou (1998:17), but there is no unique path for changes that need to be implemented in order to facilitate achievement of economic benefits from ICT diffusion. Literature reviewed indicates that SMEs that adopt the use ICT as part of their processes have a positive effect on productivity and have a great potential to support sustainable development. For ICT to be adopted, the barriers to ICT adoption need to be overcome. SMEs in Rwanda and Tanzania face challenges in getting and accessing affordable ICT infrastructure. Another challenge is human capacity, whereby skills and absorption capacity is limited and still required. Those acquiring the knowledge need to understand the impact of ICT uptake, especially advanced ICT like e-trade or e-security. There is need for Rwanda and Tanzania to have capacity in human and institutional structure that can adapt to the complications found in technological innovations. ICT business incubation can support the capacity-building of SMEs by nurturing of their technological capability. Given the challenges and resource constraints, SMEs need support to acquire technology to meet their requirements and use it to become innovative within the local

environment. It is espoused that measures need to be taken to make the technology transfer/diffusion process needs to be more effective, especially for the individual SME. SME entrepreneurs generally lack enough knowledge and experience to manage their entities and scale them up. Along these lines, business incubators in the two countries could be the catalyst for innovation, especially reverse innovation. Care should be taken so that, the emphasis of production is on the solving of local challenges in a sustainable manner and not the export of products/service to the developed nations. The digital divide and income gap between LDCs and developed countries drive the implementation of reverse innovation. As Rwanda and Tanzania strive to be industrialized economies, enabling technology transfer policies and strategies that make the resources be based and managed in the local environment s important. This allows the SMEs to decide which products should be developed and commercialized based on the requirements of the local environment, with new acquired knowledge from the developed countries. Incubators can be a vehicle that propel and harness reverse innovation in a strategic manner by SMEs.

Even though not yet conclusive, the research indicates that individual SMEs in Rwanda and Tanzania need to utilize ICT business Incubators. The entrepreneurship incubators generally provide business development services and support technology competence for technology transfer and diffusion. Incubators also support SMEs to network in the local eco-system and scale-up their products to go to market. At the same time, SMEs need to understand they play a role in the innovation system. Part of their success is the linkages they form within the technology and innovation eco-system. Another aspect to the support through business incubation is technical assistance, which looks to scale up knowledge among both users and suppliers of technology in the local environment. The literature consensus is that business incubation is a way of networking the ICT-based SMEs and related stakeholders. This could be the right strategy for Rwanda and Tanzania to synergize their efforts and resources for technology transfer/diffusion, capacity building of SMEs for sustainable development.

7.4 Implication of information communication technology transfer on policy affecting SMEs

SMEs are crucial if national inclusive growth is to be considered by Rwanda and Tanzania, to enhance social cohesion and job creation. Strategies that have been put in place include measures for their skills development, entrepreneurship development, marketing and access to finance. Never-the-less, the countries still face challenges, like, the regulations and practices governing importation of technology, recruitment of foreigners[11], which have an impact on the efficiency of acquired tools with the Rwandese and Tanzanian SME. Also to note, the empirical findings of this research indicate there are two key deficiencies that policymakers in Rwanda and Tanzania must address. The first is a lack of knowledge of ‘‘good practices’’ in the process of acquiring knowledge and know-how in SET and its application to ICT. Thus, the governments can advance the improved understanding and systems of ICT by local SMEs and put in place appropriate policies that catalyze the sustainability of these systems for economic development. Performing the above, helps contain another deficiency of under-investment in ICT-related technology. Having an ICT investment friendly ecosystem enables the SMEs in Rwanda and Tanzania to establish their own ICT investment priorities. Implementing products from ICT investment priorities helps provide access to products and services that are accessible and hopefully affordable. The governments, the private sector, society at large, and especially the R&D community in both countries must realize that ICT is not to be treated as a homogenous phenomenon, but that a heterogeneous approach to implementation involving many challenges and barriers. Having an appropriate policy framework that includes a roadmap towards the information economy could provide an opportunity to leapfrog and catch-up in the use of ICT for sustainable development. It is important for policy makers to have a holistic understanding of the innovative, entrepreneurial and technology ecosystem in order to

[11] In this cae it referes to Tanzania, Rwanda is more liberal in giving work permits

realize the potential of SET and ICT for national development. In addition, the two governments need to understand sector-specific characteristics relating to market structure and the value-chain affecting the operations of the SMEs in doing their business.

7.5 Conclusions

ICTs by themselves are not a 'silver bullet' that solves development challenges as stated in Walsham (2010:16). ICTs should be seen as an integral part of development policies and strategies aimed at improving citizens' lives in a nation. These policies should include implementation strategies that are at both national and regional[12] level, including districts. Monitoring and evaluating these policies in Rwanda with 5 provinces is easier than monitoring and evaluating the same in Tanzania, which has 31 regions and a greater population. It is important that the strategic implementation plans take into account the economic comparative advantage of each region. Targeted ICT investments in Rwanda & Tanzania can increase the probability of leapfrogging to catch up to developed countries. The economic growth potential of ICT lies in its contradictory capacities to enable homogenization as well as diversity and policy makers in Rwanda and Tanzania need to understand the role of adopting standards and regulations within this context. The ability of Rwanda and Tanzania to have sustainable development with appropriate technology is going to determined to a large extent by the capacity of their people and institutions to embrace knowledge transfer. The capability of the people and institutions to understand the complex nature inherent in technology transfer issues is important for the two countries to make the right development choices. The process of sustainable development encompasses the nations' scientific, human, organizational, technological, institutional and resource capabilities. The fundamental goal of skills-building should be to enhance the ability of policy makers and implementers in Rwanda and Tanzania to

[12] The use of "regional" is synonymous to "provinces"

evaluate and address crucial questions related to choice of technology, policy choices to enable strategic planning.

Literature reviewed and analysis of the survey results, suggest that the future of successful technology transfer depends on policies and strategies that are beneficial with appropriate and suitable capacity being created in the nation. The factors/barriers that were given high priority in the survey indicate the possibility of a correlation between technology diffusion, capacity building and sustainable development. This research has shown that the indigenous technological capabilities of Rwanda and Tanzania and their SMEs are generally weak. Also, a number of obstacles, like weak infrastructure and inadequacy of their management and organizational practice for capacity absorption, render the technology acquisition process less effective, as enumerated by Kebede and Mulder (2008:97). Given the resource constraints, ICT business incubation can support the capacity-building of SMEs by nurturing of their technological capability. With the current global competitive market and regional integration, SMEs in Rwanda and Tanzania need to acquire technology with knowledge transfer that helps them innovate and produce product for their targeted market. Business incubators could be the catalyst for this innovation.

By being in relative isolation and smaller in size, an individual SME in Rwanda or Tanzania is not in a position to address the enumerated barriers in this study on their own. Even though not yet conclusive, the research indicates that SMEs in Rwanda and Tanzania need to utilize ICT business Incubators. Reddy and Zhao (1990:12) postulate that the future of technology transfer/diffusion is dependent on appropriate human resource capacity absorption and enabling policies for the required transfer. It can be premised that, a strategy for providing/getting a skilled human resource in Rwanda and Tanzania is crucial in having absorption capacity that can undertake technology transfer schemes and adapt them to the local environment. Making ICT an integral part of the

development process in Rwanda and Tanzania requires upgrading their technical capabilities. Similarly, enhancing their capabilities to utilize ICT requires a mindset that is reinforced by commitment to build absorptive capacity of users and SMEs in the two countries. To make sure the above approach is beneficial, additional evaluation and reassessment exercises relating to the acquired technology need to be part of the strategic implementation plan and conducted to help SMEs in technology acquisition and its diffusion. Lee and Mathew (2015:9) write that while least developed countries confront many challenges, such as poor endowments of skilled labour, weak infrastructure, or financial capital, they do have certain benefits: namely, they can draw on the accrued knowledge of the developed world, and do so without the inherited constraints and inertia of the industrial leaders. Sedoyeka (2012:70) writes that on the one hand the gained positive changes collectively affect the existence and growth of ICT in the country and include socio-political and policy-making bodies which regulate ICT development. On the other hand, the policies available do not stimulate the spread of information and communication technologies, science technology and innovation, and science engineering and technology awareness. Improving the policies Rwanda and Tanzania so that they can support ICT, STI and SET initiatives will have a major impact if they are linked together. A strategy for providing/getting a skilled human resource in SET is crucial in having absorption capacity that can undertake technology transfer schemes and adapt them to the local environment. Rwanda and Tanzania can take advantage of the triple helix linkage of technology transfer, capacity building and sustainable development by utilizing HLIs, incubators and industry to implement strategic reverse innovation, among other traditional innovations. Policy considerations should take into consideration linking HLIs to development programmes and projects. If Rwanda and Tanzania were to implement the above, the links would catalyze the development of curricula, teaching methods and governance structures that lead to sustainable products and services. The result will be students with skills and knowledge necessary for traditional and reverse innovation who can transform SMEs to be able to compete and survive in business environment and

grow.

The case studies provide some guidelines to good practices that give insights into the sustainable development of a country by spurring capacity building while leveraging technology. It would be very meaningful for Rwanda and Tanzania to put in place good practices in order to mitigate potential risks of rapid ICT rollout, while benchmarking some replicable success factors. The following can be postulated for Rwanda and Tanzania:

- ICT can be used both as a tool and as an enabler in the social and economic development of the countries;
- A strategy for providing/getting a skilled human resource is crucial in having absorption capacity that can undertake technology transfer schemes and adapt them to the local environment;
- Development policies/strategies and the enactment of the associated legal/regulatory framework with inputs that have a vision for growth from all key stakeholders (both public and private) are crucial for the countries in order to have sustainable economic development;

Any evaluation of the potential for leapfrogging in Rwanda and Tanzania offered by ICTs depends upon a clear understanding of the required policy, meaningful strategy and the factors that might affect its planning or implementation. Both Rwanda and Tanzania have enacted ICT and STI policies that put an emphasis on the usage of acquired knowledge and know-how of SET for economic development. They see small and medium enterprises to be one of the prime drivers of economic growth. The challenge for technology transfer/diffusion policy is to make better the current regulatory frameworks and linking the individual policies created in "silos". This will allow for seamless implementation of ICT and technology transfer activities and ICT usage across all the plans rather than creating new independent structures/sub-plans that do not have

synergy for sustainable development. The Government of Rwanda and Tanzania think that cost, reliability and speed of national connectivity and lack of adequately trained ICT professionals are barriers to success of ICT development.

Finally, the questionnaire had been designed to get an understanding and views of SMEs using or with a potential to use ICT in Rwanda and Tanzania. The idea was to get their perception on barriers to them using ICT. Although the respective influences of each of these factors may not be mutually exclusive, however, the impacts may be push-pulled by cultural, technological and institutional challenges at the macro level in least developing economies seeking to adopt and diffuse efficient and sustainable technologies. The empirical findings on ICT transfer, capacity building and sustainable development reviewed in this exploratory research are fairly robust. This research aims to add to the knowledge with regards to how can the recipients of ICT transfer benefit from the use of the acquired technology and understand the inherent bottlenecks to growth. It provides an analysis and suggests the role policy makers can engage in to have policies and strategies that take into account the importance of linking ICT, capacity building of SMEs for sustainable development and economic growth.

7.6 Areas for further study

This exploratory study provides a starting point on researching the correlation between ICT transfer, capacity building and sustainable development. It provides the early indicators like mean differences or standardized mean differences to see if the intervention might be useful. The limitation of this research has been that understanding the relation between technology transfer/diffusion, capacity building and sustainable development propelled by ICTs is not a straight-forward matter taking into account the cultural norms in the Rwandese and Tanzanian environment.

Further research should investigate not only aspects of information communication technology transfer and its adoption but also:

- the regulatory and policy framework for economic growth and the requisite implementation process;
- The role of policy processes and institutions in leapfrogging strategies needed to be better understood, particularly which policies have been successful in developing critical absorptive capacity;
- specific policy measures that might be taken to accelerate technology transfer/diffusion for adoption by SMEs;
- the creation and nurturing of supportive systems and infrastructures to enable information communication technology transfer/diffusion and the supply chains to achieve economic and sustainable development;
- understanding the process and requisites in leapfrogging to attain the aspects of the third industrial revolution and/or fourth industrial revolution as Rwanda and Tanzania undergo industrial transformation;
- role of reverse innovation on growth models for tech SMEs in Rwanda and Tanzania.

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Appendix (Sample Questionnaires for Delphi Study)

DELPHI STUDY 1 & 2: A SURVEY ON TECHNOLOGY TRANSER, CAPACITY BUILDING AND SUSTAINABLE DEVELOPMENT

INTRODUCTION TO THE SURVEY

The way in which knowledge is processed, communications conducted, and associated products and services provided, is continuously changing, facilitated by Information and Communication Technologies (ICTs). There is a linkage between Technology Transfer (TT), Sustainable Development (SD) and Capacity Building (CB), that is propelled by knowledge, communication and services that propel development. This linkage has to be looked at by first knowing the important factors in TT, SD and CB. This survey looks to understand the key (important) factors that play a role in linking TT, SD and CB, and your assistance in filling out this survey is kindly appreciated.

Eng. George Mulamula

DELPHI STUDY 1 & 2: A SURVEY ON TECHNOLOGY TRANSER, CAPACITY BUILDING AND SUSTAINABLE DEVELOPMENT

Eng. George Mulamula
Graduate School of Technology Management
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From your experience and opinion of technology transfer situations in Rwanda/Tanzania, please rank the following technology transfer factors in the order of importance.
(Tick based on the following: 1 = Not Important; 2 = Average; 3 =Very Important)

Technology Transfer Factors	Glossary	Rank		
Absorptive capacity	Ability to value, assimilate, and apply new knowledge			

User needs	Requirements of recipients			
Medium of information exchange	Transmission materials/conduits that allow recipients to receive information			
Policies and Regulations	Legal instruments and the associated rules that are to be administered			
Incentive culture	Factors (financial or non-financial) that enables or motivates a particular course of action in the set of shared attitudes, values, goals, and practices that characterizes an institution, organization or group.			
Nature of technology	Type of material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques			
Generation of Innovation	Creation of new ideas/things and/or a new way of doing something			
Monetary cost of transfer	Price of the conveying			
Adequate infrastructure	The basic physical and organizational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function.			
Strategic partnering	Structured collaboration between organizations to take joint advantage of market opportunities, or to respond to customers more effectively than could be achieved in isolation.			
Licensing	Document giving permission under contract			
Joint ventures	An entity formed between two or more parties to undertake economic activity together			
Technology transfer indicators	Index, mark, sign or gauge as a measure of performance			

Intra-firm adaptability	Capability to disseminate information through: interdepartmental meetings, interdepartmental cooperation, contacts with customers, both internal and external			
Technology incubators	Technology programs designed to accelerate the successful development of entrepreneurial companies through an array of business support resources and services,			
Technology spin-offs	An entity or organization becomes an independent business and takes assets, intellectual property, technology, and/or existing products from the parent organization.			
Technology parks	A property development designed for a concentration of high tech, science, or research related businesses.			
Commercialization of technology	Transactions (sales and purchases) having the objective of supplying technology commodities (goods and services)			
Knowledge of opportunities	Knowing the available chances and possibilities in technology transfer			
Venture capital	Investment that is used to support new or unusual undertakings; equity, risk or speculative investment capital.			
Speed of transfer	How fast the conveyance occurs			
Enforcement of IPRs	Administration through compliance of intellectual property rights			
Quality of transferred technology	Standard of technology to be conveyed			
Recipient's knowledge level	How well-informed the receiver is			
Technical assistance	Assistance to understand the science of the technology			

Know-how transfer	Expert skills, information, or body of knowledge that (1) imparts an ability to cause a desired result, (2) is not readily available, and is (3) outside the public domain, that can be transferred			
Technical documentation	Any type of documentation that describes handling, functionality and architecture of a technical product or a product			
Understanding local needs	Knowledge of the local requirements			
Risk analysis	A technique to identify and assess factors that may jeopardize the success of a project or achieving a goal.			
Criteria for technology transfer	Standard of judgment of the process of sharing of skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments and institutions			
Country guiding technology transfer	Government showing the way in technology transfer			
Involvement of government	Government playing a role			
Involvement of local community	Local community playing a role			
Involvement of private sector	Private sector playing a role			
Consumer technology targeting	Strategizing the use of technology by specific end-user groups			
Technology marketing ability	The capability to have an integrated communications-based process through which individuals and communities are informed or persuaded that existing and newly-identified needs and wants may be satisfied by technological products and services.			
Appropriate technology application	Usage of a labour intensive, low technology, capital saving method of working which, is more suited to relatively impoverished, less developed countries suffering from high unemployment and under employment			

Technology evaluation capability	Capacity to assess the technical, economic, and competitive value of a technology.			

From your understanding of situations in Rwanda/Tanzania, please rank the following sustainability factors in the order of importance
(Tick based on the following: 1 = Not Important; 2 = Average; 3 =Very Important)

Sustainable Development Factors	**Glossary**	**Rank**		
Unemployment	Having no work			
Promotion of innovation	Advancement of new ideas			
ICT Policies and Regulations	Information Communication Technology legal instruments and the associated rules that are to be administered			
Incentive culture	Factors (financial or non-financial) that enables or motivates a particular course of action in the set of shared attitudes, values, goals, and practices that characterizes an institution, organization or group.			
Nature of technology	Type of material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques			
Research and development	Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications			
Patent protectionism	Protection of the legal rights associated with creations and inventions			

Organization strategy	The process of specifying the organization's mission, vision and objectives, developing policies and plans, often in terms of projects and programs, which are designed to achieve these objectives, and then allocating resources to implement the policies and plans and programs.			
Cost of communication	Price of transferring information from one entity to another			
Availability of basic ICT tools	Accessibility of simple technologies for gathering, storing, retrieving, processing, analyzing and transmitting information			
Adaptation of technology to local environment	Modification of the technology to fit local surroundings			
Ability to share information	Capacity to transmit information and use it in common			
Availability of skilled workforce	Access to workers who have a pre-set amount of knowledge			
Trade and investment policies	Legal instruments related to trade and investment			
Investment in technology	laying out money or capital in an enterprise with the expectation of profit in technology			
Production of technology	Processes and methods employed in transformation of tangible inputs (raw materials, semi-finished goods, or subassemblies) and intangible inputs (ideas, information, know how) into goods or services in technology			
Appropriate use of technology	Proper use of the technology			
Innovative culture	A habit of creating something new			
Availability of funds	Money being available			
Transparency	Lack of hidden agendas and conditions, accompanied by the availability of full information required for collaboration, cooperation, and collective decision making.			
Security	The state of being or feeling secure; freedom from fear, anxiety, danger, doubt, etc.;			

Intellectual Property safeguards	Protection of creations inventions, artistic expressions and other products of the imagination.			
Performance measurements	Process whereby established the parameters within which programs, investments, and acquisitions are reaching the desired results			
Access to internet	Ability to go online onto cyberspace			
Effective internet governance	The development and application by Governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet			
Investment policy	A document that formalizes an institution's guidelines for investment and asset management.			
Monopoly	When a specific individual or an enterprise has sufficient control over a particular product or service to determine significantly the terms on which other individuals shall have access to it			
Storage of content	Information stored on a database			
Stakeholder participation	Partners involved in the decision process			
Social sustainability	The idea that future generations should have the same or greater access to social resources as the current generation.			
Economic sustainability	The idea that future generations should have the same or greater access to economic resources as the current generation.			
Monitoring and evaluation	Monitoring refers to an ongoing process of assessing whether the process of planning and implementation is proceeding on target; evaluation, is an assessment of whether the various goals and objectives have been met.			
Technology grants	Sum of money provide for specific project in technology			

Technology loans	Borrowed money for project(s) in technology			
Start-up finance	Money provided to "kick-start" a technology project			
Tax incentives	A stimulus package in terms of taxes for technology investment			
Choice of technology	Selection of practical sciences to industry, including technical skills , methods and knowledge			
Enabling environment	The expression that encompasses government policies that focus on creating and maintaining an overall macroeconomic environment that brings together suppliers and consumers in an inter-firm co-operation manner			
Allignment of interest between source and recipient	Giver and end-user of technology having the same concern and/or objectives			
Replicability of technology	Ability to copy the technology			
Decision-making process	An outcome of mental processes cognitive process leading to the selection of a course of action among several alternatives			
Liberization policies	Removal of or reduction in the practices that thwart free flow of goods and/or services from one nation to another.			
Attraction of FDI	Inflow of investment of foreign assets into domestic structures, equipment, and organizations.			
Public Private Partnerships	Involvement of private enterprise (in the form of management expertise and/or monetary contributions) in the government projects aimed at public benefit			
Linkages with local firms	Source companies having a connection to local companies			
Technology innovation capability	The capacity to create new things in the field of technology			
Adult secondary (tertiary) schooling attainment level	The proportion of the population of working age (25-64 years) which has completed at least (upper) secondary education.			

Adult literacy rate	The proportion of the adult population aged 15 years and over that has the ability to identify, understand, interpret, create, communicate, compute and use printed and written materials associated with varying contexts			
Gross Domestic Product (GDP) per capita	The total market value of all final goods and services produced in a country in a given year.			
Investment share in GDP	The share of investment in relation to total production.			
Internet users per population	Internet users are those who use the Internet (World Wide Web) from any location			
Gross domestic expenditure on R&D as a percentage of GDP	Gross domestic expenditure on scientific research and experimental development (R&D) expressed as a percentage of Gross Domestic Product (GDP)			
Inflation rate	The indicator is defined as the annual percentage increase of the consumer price index.			
Percentage of population with access to primary health care facilities	Proportion of population with access to primary health care facilities, i.e., essential health care made accessible at a cost the country and community can afford, with methods that are practical, scientifically sound and socially acceptable.			

From your experience and opinion of technology transfer situations in Rwanda/Tanzania, please rank the following capacity building factors in the order of importance
(Tick based on the following: 1 = Not Important; 2 = Average; 3 =Very Important)

Capacity Building Factors	**Glossary**	**Rank**		
Knowledge transfer	Transfer of skills acquired by a person through experience or education and what is known in a particular field or in total			
User needs	Requirements of recipients			
Recipient attitude to technology	Opinion of receiver's to the technology			

Policies and Regulations	Legal instruments and the associated rules that are to be administered			
Incentive culture	Factors (financial or non-financial) that enables or motivates a particular course of action in the set of shared attitudes, values, goals, and practices that characterizes an institution, organization or group.			
Nature of technology	Type of material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques			
Language	Specialized vocabulary used in communication			
Readiness for absorption of technology	Being ready for technology integration of change and innovation into an organization's culture and operations			
Evaluation of technology	Evaluation of practical sciences to industry, including technical skills , methods and knowledge			
Change management	The process during which the changes of a system are implemented in a controlled manner by following a pre-defined framework/model with, to some extent, reasonable modifications			
Collaboration and networking	Working together and inter-connecting with other people and entities			
Ease of understanding the tools	Understanding the tools in technology with simplicity			
Leadership	Ability to command and lead others			
Infrastructure services	Services offered to physical structures hosting transferred technologies			
Locally adapted	Changed to suit local environment			
Locally appropriate	Suited to be used in the local environment			

Support for capacity building institutions	Assistance to entities that do the following: Human resources development/training, Education/building awareness, Institutional strengthening, including local participation			
Monitoring and evaluation	Monitoring refers to an ongoing process of assessing whether the process of planning and implementation is proceeding on target; evaluation, is an assessment of whether the various goals and objectives have been met.			
Building awareness	Sensitization of the recipients and community			
Dynamic private sector	An active private sector			
Brain drain	depletion or loss of intellectual and technical personnel			
Ability to negotiate	Ability to bargain			
International linkages (networking)	Source companies having a connection to international companies			
Interaction between researchers and commercial people	A relationship involving those doing scientific studies and business people			
Technology cooperation	Collaboration to create new things in the field of technology			
Technology innovation	Creating new things in the field of technology			
Appropriate investments	Proper expenditure in technology			
Nurturing knowledge-based development	Cultivating information-based development			
Training	Educating			
Post analysis of transferred technology	Evaluating conditions after to technology transfer			
Third party institution support of transferred technology	For transferred technology, assistance coming from neither the source nor the recipient			
Communication skills	Having interpersonal, oral and written communication including the ability to explain complex and or technical information using clear and simple language			

Availability of resources	Accessible of personnel and major items of equipment, supplies, and facilities that are available for assignment to incident operations			
Technology gap assessment	Evaluation the difference between those who have technology and high-tech devices in general and those who do not			
Applying know-how	Using the expert skills, information, or body of knowledge that (1) imparts an ability to cause a desired result, (2) is not readily available, and is (3) outside the public domain, that can be transferred			
Ability to assess performance	Capacity to measure the results of programs and investments			
Ability to assess financial performance targets	Capacity to measure the financial parameters of programs			
Social acceptance of technology	To tolerate, differences and diversity among recipients of the technology			
Training of technical staff	Educating the implementers of the technology			
Training of end users of technology	Educating the recipients who will be users of the technology			
Higher Learning Institution curricula matching transfer needs	Content of the course of study in Universities and Colleges			
Policies for competitive market	Legal instruments for a market where no entity has the power to affect the market price of a good			
Incentives for new technologies	Stimulation for the creation of new ideas and things			
Promotion of business alliances	Advancing business collaboration			

Optional Info:

If you feel you would like to contribute further in this survey, please provide us with your contact details below.

Name.....

Email:.....

Address and Tel No:.....

DELPHI STUDY 3: A SURVEY ON TECHNOLOGY TRANSER, CAPACITY BUILDING AND SUSTAINABLE DEVELOPMENT

INTRODUCTION TO THE SURVEY

Technology diffusion and transfer through small business incubation is seen as a formidable method to propelling development in the country. The Government is now turning to ICT-based Small and Medium Enterprises (SMEs) and providing business development services, which include mentoring, knowledge transfer, coaching and networking to get technology diffusion. This survey looks to understand the key (important) factors that play a role in linking Technology Transfer, Sustainable Development and Capacity Building, and your assistance in filling out this survey is kindly appreciated.

Eng. George Mulamula

DELPHI STUDY 3: A SURVEY ON TECHNOLOGY TRANSER, CAPACITY BUILDING AND SUSTAINABLE DEVELOPMENT FOR ICT SMEs

From your experience and understanding, please rank the following **technology transfer factors** affecting ICT Small and Medium Enterprises (SMEs) in the order of importance.
(Fill based on the following: 1 = Not Important; 2 = Little Importance; 3 = Important; 4 = Very Important)

Technology Transfer Factors	Glossary	Rank			
Commercialization of SME technology products	Transactions (sales and purchases) having the objective of supplying technology commodities (goods and services)				
Knowledge of opportunities by SMEs	Knowing the available chances and possibilities in technology transfer				
Venture capital/ Angel Investment	Investment that is used to support new or unusual undertakings; equity, risk or speculative investment capital.				
Quality of transferred technology	Standard of technology to be conveyed				
Risk analysis of transfer	A technique to identify and assess factors that may jeopardize the success of a project or achieving a goal.				

Technology marketing ability of SME	The capability to have an integrated communications-based process through which individuals and communities are informed or persuaded that existing and newly-identified needs and wants may be satisfied by technological products and services.				
Conducive policies and regulations affecting SMEs	Legal instruments and the associated rules that are to be administered				
Technology incubators for SMEs	Technology programs designed to accelerate the successful development of entrepreneurial companies through an array of business support resources and services,				
Delivery of technology and systems	The methodology used by technology transferees provide the technology to recipients				
Having on-site expert and on-line assistance when delivering and supporting technology transfer projects to SMEs	Customer service that is post-implementation support in using the technology				

From your understanding of sustainability situations, please rank the following **sustainability development factors** affecting ICT Small and Medium Enterprises (SMEs) in the order of importance.
(Fill based on the following: 1 = Not Important; 2 = Little Importance; 3 = Important; 4 = Very Important)

Sustainable Development Factors	**Glossary**	**Rank**			
Research and Development in SME environment	Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications				
Patent protectionism	Protection of the legal rights associated with creations and inventions				
Organization strategy of SME	The process of specifying the organization's mission, vision and objectives, developing policies and plans, often in terms of projects and programs, which are designed to achieve these objectives, and then allocating resources to implement the policies and plans and programs.				

Adaptation of technology to local environment	Modification of the technology to fit local surroundings				
Availability of skilled workforce	Access to workers who have a pre-set amount of knowledge				
Investment in technology	laying out money or capital in an enterprise with the expectation of profit in technology				
Innovative culture in SME community	A habit of creating something new				
Technology loans for SMEs working in the idea and innovation space	Borrowed money for project(s) in technology that are not always assets based with quick ROI				
Start-up finance for SMEs	Money provided to "kick-start" a technology project				
Gross domestic expenditure on R&D as a percentage of GDP	Gross domestic expenditure on scientific research and experimental development (R&D) expressed as a percentage of Gross Domestic Product (GDP)				

From your experience,, please rank the following **capacity building factors** affecting ICT Small and Medium Enterprises (SMEs) in the order of importance.
(Fill based on the following: 1 = Not Important; 2 = Little Importance; 3 = Important; 4 = Very Important)

Capacity Building Factors	**Glossary**	**Rank**			
User needs	Requirements of recipients				
Ability to assess financial performance targets	Capacity to measure the financial parameters of programs				
Support for capacity building institutions	Assistance to entities that do the following: human resources development/training, education/building awareness, Institutional strengthening, including local participation				
Training	Educating				
Applying know-how	Using the expert skills, information, or body of knowledge that (1) imparts an ability to cause a desired result, (2) is not readily available, and is (3) outside the public domain, that can be transferred				

Training of end users of technology	Educating the recipients who will be users of the technology				
Higher Learning Institution curricula matching transfer needs	Content of the course of study in Universities and Colleges				
Incentives for new technologies	Stimulation for the creation of new ideas and things				
Promotion of business alliances	Advancing business collaboration				
Formal learning as a tool for competence and growth of the SME	Formal learning is education and training at institutions, leading to recognised diplomas and qualifications				

Optional Info:

DELPHI STUDY 4: A SURVEY ON CORRELATION BETWEEN TECHNOLOGY TRANSFER, CAPACITY BUILDING AND SUSTAINABLE DEVELOPMENT FOR ICT SMEs

INTRODUCTION TO THE SURVEY

Technology diffusion and transfer through small business incubation is seen as a formidable method to propelling development in the country. The Government is now turning to ICT-based Small and Medium Enterprises (SMEs) and providing Incubation with business development services, which include mentoring, knowledge transfer, coaching and networking to get technology diffusion. This survey looks to understand the key (important) factors that play a role in linking Technology Transfer, Sustainable Development and Capacity Building, and your assistance in filling out this survey is kindly appreciated.

Eng. George Mulamula

A SURVEY ON TECHNOLOGY TRANSER, CAPACITY BUILDING AND SUSTAINABLE DEVELOPMENT FOR ICT SMEs

The following provides a general definition of the Technology Transfer, Sustainable Development and Capacity Building terms used in this survey, for ease of understanding.

Technology Transfer Factors	Glossary
Commercialization of SME technology products	Transactions (sales and purchases) having the objective of supplying technology commodities (goods and services)
Knowledge of opportunities by SMEs	Knowing the available chances and possibilities in technology transfer
Venture capital/ Angel Investment	Investment that is used to support new or unusual undertakings; equity, risk or speculative investment capital.
Quality of transferred technology	Standard of technology to be conveyed
Risk analysis of transfer	A technique to identify and assess factors that may jeopardize the success of a project or achieving a goal.
Technology marketing ability of SME	The capability to have an integrated communications-based process through which individuals and communities are informed or persuaded that existing and newly-identified needs and wants may be satisfied by technological products and services.
Conducive policies and regulations affecting SMEs	Legal instruments and the associated rules that are to be administered
Technology incubators for SMEs	Technology programs designed to accelerate the successful development of entrepreneurial companies through an array of business support resources and services,
Delivery of technology and systems	The methodology used by technology transferees provide the technology to recipients
Having on-site expert and on-line assistance when delivering and supporting technology transfer projects to SMEs	Customer service that is post-implementation support in using the technology

Sustainable Development Factors	Glossary
Research and Development in SME environment	Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications
Patent protectionism	Protection of the legal rights associated with creations and inventions
Organization strategy of SME	The process of specifying the organization's mission, vision and objectives, developing policies and plans, often in terms of projects and programs, which are designed to achieve these

	objectives, and then allocating resources to implement the policies and plans and programs.
Adaptation of technology to local environment	Modification of the technology to fit local surroundings
Availability of skilled workforce	Access to workers who have a pre-set amount of knowledge
Investment in technology	laying out money or capital in an enterprise with the expectation of profit in technology
Innovative culture in SME community	A habit of creating something new
Technology loans for SMEs working in the idea and innovation space	Borrowed money for project(s) in technology that are not always assets based with quick ROI
Start-up finance for SMEs	Money provided to "kick-start" a technology project
Gross domestic expenditure on R&D as a percentage of GDP	Gross domestic expenditure on scientific research and experimental development (R&D) expressed as a percentage of Gross Domestic Product (GDP)

Capacity Building Factors	**Glossary**
User needs	Requirements of recipients
Ability to assess financial performance targets	Capacity to measure the financial parameters of programs
Support for capacity building institutions	Assistance to entities that do the following: human resources development/training, education/building awareness, Institutional strengthening, including local participation
Training	Educating
Applying know-how	Using the expert skills, information, or body of knowledge that (1) imparts an ability to cause a desired result, (2) is not readily available, and is (3) outside the public domain, that can be transferred
Training of end users of technology	Educating the recipients who will be users of the technology
Higher Learning Institution curricula matching transfer needs	Content of the course of study in Universities and Colleges
Incentives for new technologies	Stimulation for the creation of new ideas and things
Promotion of business alliances	Advancing business collaboration
Formal learning as a tool for competence and growth of the SME	Formal learning is education and training at institutions, leading to recognised diplomas and qualifications

RELATION BETWEEN CAPACITY BUILDING AND SUSTAINABLE DEVELOPMENT FACTORS

Capacity Building Factors	From your experience and understanding, please rank the following Capacity Building Factors on how they relate to the Sustainable Development Factors affecting ICT Small and Medium Enterprises (SMEs) in the order of importance. ***(Fill based on the following: 1 = Not Important; 2 = Little Importance; 3 = Important; 4 = Very Important)*** **Sustainable Development Factors**									
	Research and Development in SME	Patent protectionism	Organization strategy of SME	Adaptation of technology to local environment	Availability of skilled workforce	Investment in technology	Innovative culture in SME community	Technology loans for SMEs working in the idea and innovation space	Start-up finance for SMEs	Gross domestic expenditure on R&D as a percentage of GDP
User needs										
Ability to assess financial performance targets										
Support for capacity building institutions										
Training										
Applying know-how										
Training of end users of technology										
Higher Learning Institution curricula matching transfer needs										
Incentives for new technologies										
Promotion of business alliances										
Formal learning as a tool for competence and growth of the SME										

RELATION BETWEEN SUSTAINABLE DEVELOPMENT FACTORS AND TECHNOLOGY TRANSFER FACTORS

Sustainable Development Factors	From your experience and understanding, please rank the following Sustainable Development Factors on how they relate to the Technology Transfer Factors affecting ICT Small and Medium Enterprises (SMEs) in the order of importance. ***(Fill based on the following: 1 = Not Important; 2 = Little Importance; 3 = Important; 4 = Very Important)*** **Technology Transfer Factors**									
	Commercialization of SME technology products	Knowledge of opportunities by SMEs	Venture Capital/ Angel Investment	Quality of transferred technology	Risk analysis of transfer	Technology marketing ability of SME	Conducive policies and regulations affecting SMEs	Technology incubators for SMEs	Delivery of technology and systems	Having on-site expert and on-line assistance when delivering and supporting technology transfer projects to SMEs
Research and Development in SME environment										
Patent protectionism										
Organization strategy of SME										
Adaptation of technology to local environment										
Availability of skilled workforce										
Investment in technology										
Innovative culture in SME community										
Technology loans for SMEs working in the idea and innovation space										
Start-up finance for SMEs										
Gross domestic expenditure on R&D as a percentage of GDP										

RELATION BETWEEN CAPACITY BUILDING FACTORS AND TECHNOLOGY TRANSFER FACTORS

Capacity Building Factors	From your experience and understanding, please rank the following Capacity Building Factors on how they relate to the Technology Transfer Factors affecting ICT Small and Medium Enterprises (SMEs) in the order of importance. ***(Fill based on the following: 1 = Not Important; 2 = Little Importance; 3 = Important; 4 = Very Important)*** **Technology Transfer Factors**									
	Commercialization of SME technology products	Knowledge of opportunities by SMEs	Venture Capital/ Angel Investment	Quality of transferred technology	Risk analysis of transfer	Technology marketing ability of SME	Conducive policies and regulations affecting SMEs	Technology incubators for SMEs	Delivery of technology and systems	Having on-site expert and on-line assistance when delivering and supporting technology transfer projects to SMEs
User needs										
Ability to assess financial performance targets										
Support for capacity building institutions										
Training										
Applying know-how										
Training of end users of technology										
Higher Learning Institution curricula matching transfer needs										
Incentives for new technologies										
Promotion of business alliances										
Formal learning as a tool for competence and growth of the SME										