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**SUITABLE INDICATORS FOR MEASURING THE IMPACT OF THE ICT FOR
DEVELOPMENT (ICT4D) PROCESS***

Keynote paper

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* Due to the late submission, this paper could neither be translated nor reproduced and has been posted on Internet as submitted by the author.

Introduction

The world economy is experiencing the effects of rapid globalization and liberalization as well as the impact of the emerging information age; this is no doubt bringing about a new global economic order to be dominated by information and knowledge-based economies. According to [1] the emerging information age characterized by information and communication technologies (ICTs) and the extraordinary increase in the spread of knowledge has given birth to a new era: that of knowledge and information. Information and communication technologies in one form or another are now a pervasive feature of most economies [see **Box 1**].

There is no doubt that: the emergence of the information age has brought to the fore, the important role that *information*, *knowledge* and *technology* can play in facilitating socio-economic development. The effective use of information and knowledge is becoming the most critical factor for rapid economic growth and wealth creation, and for improving socio-economic well-being.

Box 1: What Are Information and Communications Technologies (ICTs)?

The ICT infrastructure by definition cut across a variety of technologies and delivery media for supporting the transmission of voice, data and video. It encompasses: *transmission, delivery and communications infrastructure* for voice, data and video including: telecommunication infrastructure: fixed line, wireless, satellite-based and mobile infrastructure; communication and network infrastructure including local and wide area communication and computer networks for voice, data and video; broadcasting networks including radio and TV network infrastructure as well as the Internet --- incorporating elements of computers, telecommunications and communications technologies to form an integrated multimedia infrastructure with a global reach.

Other technologies that are normally regarded as ICTs also include: production technologies including those used in computer-integrated manufacturing (CIM) and production systems and operations; computer-based technologies for supporting specific operations & activities in agriculture, industry and commerce; educational computer-mediated delivery technologies for supporting teaching, learning and training; computer-based technologies used for supporting health delivery operations and systems, including those used in computer-aided surgery, and ICUs, robotics technologies used in a variety of industrial processes, and manufacturing operations; and microchip technologies used in ranges of consumer products, like: watches, cars, fridges, TVs, radios washing machines

1.0 On the Role of ICTs in Economic and Social Transformation

It has been established in [2] that: information; knowledge and technology are increasingly becoming the key drivers for socio-economic development world-wide. A nation's capability to accelerate its socio-economic development process and gain global competitiveness and improve the well-being of its people depends on the extent to which it can develop, use, exploit and sell, ---- *information*, *knowledge* and *technology* in one form or another. There is now a consensus that development without the development, deployment and exploitation of ICTs within key sectors of the economy is not possible.

In the case of developing countries, it has been acknowledged that: for them to move their industrially weak, subsistence agriculture based economy towards an information and knowledge-based economy [as described in **Box 2**], these countries will need to develop and implement a comprehensive ICT-led socio-economic development policies, strategies and plans.

Box 2: Characterizing the Information and Knowledge-based Economy (IKE)

- A high income economy dominated by trading in ICT products and services
- An economy characterized by a large commercial services sector with a reasonably large and vibrant ICT services sector and industry
- An economy characterized by a technology-based knowledge-driven industrial
- An economy with a globally competitive industrial and services sector which are to a large extent driven by cutting-edge R&D encompassing basic and applied industrial and product development.
- An economy based on a rich pool of highly skilled human resources in critical skill areas relevant for developing and maintaining a competitive edge on the global market
- An economy in which the majority of the working population are either directly or indirectly involved in information and communications related activities
- An economy with a modern, efficient and competitive agricultural sector
- An economy characterized by a wide-spread deployment and exploitation of ICTs within the society to support the delivery of health, education, government and social services
- An economy characterized by a modern educational system within which ICTs are widely deployed to facilitate the delivery of educational services at all levels of the educational system
- An economy in which a reasonable large proportion of the population have access to information and communications technology products and services
- An economy in which the provision and delivery of goods and services of the key sectors of the economy are to a large extent facilitated by information and communications technologies
- An economy in which the provision and delivery of services by government and its administrative machinery are to a large extent facilitated by information and communications technologies
- An economy based on an advanced and reliable national information and communications infrastructure
- An economy based on an advanced and reliable national information and communications infrastructure
- An economy based on a literate society with a high proportion of computer literates

The argument is that: with the right sets of policies and action plans it will be possible for developing countries to facilitate their socio-economic development process through the development, deployment and exploitation of ICTs within the economy and society without first going through an extensive industrialization process.

It is however recognized that for these policies to make an appreciable desirable impact on the socio-economic development process of these developing countries they will need to be integrated into their country's overall developmental objectives, priorities and programmes. Such an all-inclusive comprehensive ICT4D policy and strategies must be aimed at the implementation of initiatives that could contribute to addressing the key developmental challenges facing these countries.

2.0 An Overview of National ICT4AD Efforts in Some Selected African Countries

A number of countries in the developed and developing world, recognizing the crucial role of ICTs in facilitating development, have put in place ICT policies and strategic action plans to facilitate the process of transforming their economies and societies. In Africa for example, a number of the countries under the auspices of the African Information Society Initiative (AISII) of the United Nations Economic Commission for Africa (UNECA) have either completed or are in the process of developing their ICT for Development (ICT4D) policies and plans to facilitate their development process.

To aid process of identifying the main building blocks and elements of national ICT4D policy initiatives to serve as a basis for exploring the development of the relevant indicators for measuring the impact of the ICT4D process, we briefly review below the case of a selected number of African countries.

- **The Case of Mauritius**

The Government of Mauritius has been active in the promotion of information and communication technology in every socio-economic sphere and steering the country towards the information age. In fact, Mauritius in the late 1990's was one of the first African countries to develop its National Information Technology Strategy Plan (NITSP) [3] to serve as a comprehensive, dynamic and integrated strategic plan for the realization of Mauritius' IT vision. This vision forms an integral part of the overall national vision of social and economic development for Mauritius.

To realize the NITSP vision, the following six objectives were targeted for implementation:

- Enable the services sector to grow and develop into a business hub;
- Improve effectiveness and efficiency of public services;
- Bring the Government closer to the people;
- Create a fully IT literate nation;
- Use IT to enhance the education system and services; and
- Enhance competitiveness of businesses in the global market.

- **The Case of Rwanda**

The Rwandan ICT-led development policy [4] targeted among other areas the: creation of an enabling environment for the development of the national information society and economy; implementation of special policy instruments, and incentive programmes to promote the development of the information economy; development of the necessary human resource to support the development of the country's information society and economy; deployment and exploitation of ICTs in the educational system; and the deployment of ICTs to support the operations of the civil and public services.

To implement the details of its ICT-led development policy the Rwandan Government developed a comprehensive five year Plan to serve as the first of four 5 year ICT4AD --- NICI plans that will be implemented over a 20 year time span. The eight pillars of the Rwanda 1st NICI Plan which is based on the SUNRISE Model are:

- Human Resource Development;
- ICTs in Education;
- Facilitating Government Administration and Service Delivery;

- Developing and Facilitating the Private Sector;
- Deployment and Spread of ICTs in the Community;
- ICT Infrastructure Development, Legal Regulatory; Institutional Provisions and Standard; and
- Foreign Direct Investment Drive in ICTs Sub-Plan.

The Case of Ghana

The overall objective of the Ghana's ICT4D policy is to engineer an ICT-led socio-economic development process with the potential to transform Ghana into a middle income, information-rich, knowledge-based and technology driven economy and society. The policy is strategically focused on the development of the ICT sector and industry and as well as on using ICTs as a broad-base enabler of developmental goals, with emphasis of the development, deployment and exploitation of ICTs to aid the development of all other sectors of the economy.

The Policy addresses 14 priority focus areas or pillars namely:

- Accelerated Human Resource Development
- Promoting ICTs in Education – The Deployment and Exploitation of ICTs in Education
- Facilitating Government Administration and Service Delivery
- Facilitating the Development of the Private Sector
- Developing an Export-Oriented ICT Products and Services Industry
- Modernization of Agriculture and the Development of an Agro-Business Industry
- Developing a Globally Competitive Value-Added Services Sector --- A Regional Business Service and ICT Hub
- Deployment and Spread of ICTs in the Community
- Rapid ICT and Enabling Physical Infrastructure Development
- R&D and Scientific and Industrial Research Capacity Development
- Legal, Regulatory, and Institutional Framework Provisions
- Promoting Foreign and Local Direct Investment Drive in ICTs

- **The Case of Nigeria**

Nigeria in 2000 developed its national information technology policy, with the vision to make Nigeria an IT capable country in Africa and a key player in the information society by the year 2005, using IT as the engine for sustainable development and global competitiveness. The Government in its policy document recognizes IT as a strategic imperative for national development and has resolved to provide considerable national resources, both financial and otherwise for the realization of the National IT Vision statement.

The Nigerian IT policy framework [5] target a number of strategic areas for implementation, the key ones are: Human Resource development; Infrastructure development; Governance; Research and Development (R&D); Health; Agriculture; Urban and Rural Development; Trade and Commerce; Fiscal Measures; Government and Private Sector Partnerships; Arts, Culture & Tourism; National Security and Law Enforcement; Legislation; IT Popularization and Awareness.

- **The Case of Uganda**

Uganda under the auspices of the AISI initiative of the ECA initiated its ICT for development (or NICI) process in 2000, this lead to the development of its ICT policy document in 2002 [6]. The government as

part of its ICT policy document, recognises the important role that ICTs could play in national development and is committed to the championing the development and the use of ICTs in Uganda. The key objectives of the ICT policy include to:

- Sensitize and create awareness among the general public and all stakeholders about the role of information and ICTs in Uganda's development
- Increase the level of ICT functional literacy in all sectors and build human resource capacity
- Promote and enable the building and establishment of an appropriate infrastructure that supports ICT development and at the same time meets universal ICT access goals
- Promote fair competition and private investment in the ICT sector with particular emphasis on development and encouragement of local participation including specific incentives for investing in ICTs
- Identify and establish innovative financing mechanism that address specific needs of ICT development and
- Promote the use of ICTs in the stimulation of production, storage, and dissemination of in-country information and knowledge in both the public and private sector.

- **The Case of Tanzania**

Tanzania has put in place its national ICT policy framework with the vision to transform the country into information rich, knowledge based society and economy [7]. The mission identified for the realization of the vision is to: speedily achieve social – economic development of Tanzania through modernizing key sectors of the economy using ICTs and investment in the ICT sector. The priority areas identified for implementation within the policy framework are:

- Education
- Human Resource Development
- Government
- Health
- Infrastructure Development
- Higher Education and Research
- Universal Access
- ICT leadership

Box 3: Summary of Key Components of ICT4D Policies and Plans

Based on the above review of the ICT policy initiatives in selected African countries, the following broad areas can be identified as indicative focus areas or pillars (building blocks) of national ICT4D policy initiatives:

- Infrastructure Development
- Human Resource Development
- Promoting Universal Access and Service
- Government Administration and Service Delivery – E-Government
- Promoting Electronic Commerce and the Development of the Private Sector
- Developing Key Sectors of the Economy: Agriculture, Services and the ICT Industry
- Promoting ICTs Deployment in Social Sectors: Education, Health, and Community
- Promoting Research and Development
- Legal, Regulatory and Institutional Framework and Environment
- National Security and Law and Order

The above broad policy focus areas derived from on-going ICT4D initiatives of selected African countries reflects the main policy action points of the WSIS process and as such provides a suitable basis for guiding the process of the development of suitable indicators for supporting the ICT4D process in both the developed and developing countries. We in section 3.0 use these broad policy areas to serve as the building blocks to facilitate the process of developing of suitable indicators for measuring the information economy.

3.0 The Need for Developing Indicators for Measuring the Information Economy

According to [8] information society measures are increasingly gaining attention, given that very little is known about the extent to which ICTs are actually used by people. Despite the fact the ICTs has for sometime now been deployed to support activities and operations within the public and private sectors of most developed and developing countries, most National Statistical Organizations are yet to develop and integrate socio-economic related ICT indicators into their national statistical system.

Not very much is known of the impact of the development, deployment and the exploitation of ICTs on economic growth, Gross Domestic Product (GDP) and for that matter the Gross National Income (GNI) of most countries. The sectorial impacts of ICT4D policies are not yet quantified and understood in most countries. And in the case of developing and some developed countries, indicators for monitoring, assessing and measuring the impact of investments in pilot and national ICTs initiatives like e-commerce, e-education, e-government, telecenters, telemedicine etc on households, targeted beneficiaries and the economy are non existent in most cases.

Also as pointed out in [8] the designing and implementing of ICT policies and strategies without proper knowledge about the state of ICT in the country, their use by companies and individuals, or the main barriers to them, remain a challenging tasks for most countries. The need for developing suitable indicators for inclusion in baseline or e-readiness studies to support ICT4D policy and plan development process is as crucial as developing suitable indicators to facilitate ‘impact’ analysis of the ICT4D process.

3.1 The Baseline Concept: Supporting the Policy and Plan Development Process

Some countries have in fact based their policy and plan development process on ICT4D Baseline or e-readiness studies. These studies often focus on the analysis of the status of the development, deployment and the exploitation of ICTs within the economy and society to facilitate the process of identifying and crystallizing policy initiatives and to provide a basis for setting targets and projections for the various programmes and initiatives of the ICT4D Plan. **Annex A** illustrates the details of a methodological framework for carrying out such Baseline Studies. This framework was used to guide ICT4D baseline studies in a number of African countries including: Nigeria, Ghana, Ethiopia and Rwanda.

3.2 Going beyond the Indicators: Measuring social and Economic Impact of ICT4D Efforts

Given that a number of countries in both the developed and developing world are now in the process of implementing their ICTAD policies and plans, it is recognized that for most of these countries, the next stage in the process is to develop suitable indicators for monitoring, assessing and measuring the impact of the development of their information economies. However evidence shows that most countries including those in the advanced stages of implementing their ICT4D policies and plans are yet to develop such comprehensive sets of statistical indicators as part of their national statistical system targeted at measuring the development and the impact of the information and knowledge economy.

These indicators it is argued will be required to monitor the implementation of the ICT policy initiatives with a view to ensure that targets set are being met and more importantly to measure the socio-economic development impact of these policy initiatives. Specifically there is a need to monitor the implementation process to establish the extent to which the policies and corresponding action plans are actually achieving the desired and intended policy objectives of developing the information economy and society.

On the Question of Impact Measurement

The basic question relating to ‘impact’ monitoring, assessment and measurement can be address at two levels: *What to measure?*, and *How to Measure?*. The question of: ‘what to measure’ is closely associated with the notion of: “*type of impact*”; and that of ‘how to measure’ relates to the notion of which “*indicators*” to use to measure impact. We can distinguish between three possible broad types of ‘impact’ of ICT4D policy initiatives: *social, economic, infrastructural* and *institutional*. For each of these we can identify a number of categories or indicative focus areas of indicators as illustrated in Table 1 below.

Table 1: Classification of Types of Impact Assessment and Measurement	
Type of Impact	Categories/Indicative Focus Areas of Indicators
Social	Education (improving access, services and outcomes) Health (improving access, services and outcomes) Social Services (improving access, services and outcomes) Households (income levels, socio-economic well-being)
Economic	Growth [Economy, Agriculture, Industry and Manufacturing, Services] Productivity [Agriculture, Industry and Manufacturing, Services] GDP [Economy, Agriculture, Industry and Manufacturing, Services] GNI [Economy, Agriculture, Industry and Manufacturing, Services] Employment Levels [Economy, Agriculture, Industry & Manufact, Services]
Infrastructural and Capacity	Telecom and Communications Infrastructure Transport and Energy Infrastructure Human Resource Capacity
Institutional	Organizational Structure and Operations Productivity Levels Efficiency and Effectiveness Improvements

4.0 Proposed Frameworks for Developing Indicators for Measuring the Development and the Impact of the Information Economy and Society

We propose in this section a number of methodological frameworks for developing suitable indicators for measuring the impact of the ICT for Development process. Underlying these methodological frameworks is a classification system detailed below for identifying broad types of socio-economic related ICT indicators.

4.1 A Classification System for Information and Knowledge Society and Economy Indicators:

Classification of suitable indicators can be done in terms of: (i) key sectors of the economy; (ii) ICTAD broad application areas like: e-government, e-commerce, telemedicine etc, (ii) the characteristics or features of the information and knowledge economy (see **Box 2**) and (iii) the focus areas or pillars of ICTAD policy initiatives (see **Box 3**); For each of these, it is possible to identify the *baseline/e-readiness* type of indicators as against *impact assessment* or measurement type of indicators.

Table 2: Cross-Classification System of Indicators				
Classification	Type of ICT4D Indicators			
	Baseline/Readiness Indicators		Impact Assessment Indicators	
Key Sectors of the Economy	Broad Indicators	Specific Indicators	Broad Indicators	Specific Indicators
Broad ICT4D Application Areas	Broad Indicators	Specific Indicators	Broad Indicators	Specific Indicators
ICTAD Policy Focus Areas	Broad Indicators	Specific Indicators	Broad Indicators	Specific Indicators
Features of the IKE	Broad Indicators	Specific Indicators	Broad Indicators	Specific Indicators

4.2 FRAMEWORK A: Developing Indicators for Key Sectors of the Economy

The development of ICT-related indicators for key sectors of the economy will provide a basis for the integration of these indicators into national statistical systems – which by tradition classify information in social and economic indicators in terms of key sectors. The key sectors of the economy that could be targeted for the ICT-related indicators include : ICT sector/industry; Services, Industry and Commerce, Agriculture, Education, Health, and Government and public sector.

The ICT4D Baseline Study framework described in **Annex A** and the Scan-ICT Methodology in **Annex B** provides a comprehensive framework for sector-by-sector classification of socio-economic related ICT indicators. The Scan-ICT methodology was developed as part of an IDRC (International Development Research Center) and UNECA (United Nations Economic Commission for Africa) pilot project involving: Ghana [9], Uganda, Ethiopia, Morocco Mozambique and Senegal.

4.3 FRAMEWORK B: Developing Broad ICT4D Application Area-Specific Indicators

Indicators can also developed to measure the status of the deployment and exploitation of ICTs to implement broad application areas like: e-government, e-commerce and business, e-education, e-health and telemedicine applications among others. It is possible to also develop some specific indicators to measure the social, economic, infrastructural and institutional impact of the implementation of these applications as part of monitoring the development and the impact of the ICT4D process within a given country. The methodological framework proposed by UNCTAD [8] focusing on developing indicators for measuring the e-business aspects of the information society could serve as a basis for developing broad application-specific types of indicators.

4.4 FRAMEWORK C: Classification of Indicators in terms of ICT4D Policy Focus Areas (Pillars)

The ICT4D policy focus areas or pillars summarized in **Box 3** also provides a suitable framework or reference point for identifying and developing key indicators for measuring the information society and economy. We identify below, for each of these pillars, broad types of suitable indicators classified in terms of: baseline/e-readiness type of indicators and impact monitoring and assessment types of indicators.

ICTAD Policy Pillar	Broad Types of Suitable Indicators
<p align="center">ICT Infrastructure Development</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators on the level of deployment and the geographical spread of ICT infrastructure: telecommunication infrastructure (fixed line, mobile, satellite, national backbone infrastructure); communications and computer networks infrastructure; Internet Infrastructure and Intentional and Local Bandwidth, Broadcasting infrastructure (radio and TV); Transport infrastructure, Power infrastructure</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators on the extent of the development, deployment and utilization of ICT infrastructure: telecommunication infrastructure (fixed line, mobile, satellite, national backbone infrastructure); communications and computer networks infrastructure; Internet Infrastructure and Intentional and Local Bandwidth, Broadcasting infrastructure (radio and TV); Transport infrastructure, Power infrastructure</p>

ICTAD Policy Pillar	Broad Types of Suitable Indicators
	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators on ICT Human Resource Capacity; Human Resource Capacity in key Skill Areas; Human Resource Capacity in Key Sectors of the Economy: Agriculture, Services and Industry.</p> <p>Indicators on the Human Resource Development Capacity of the Universities,</p>

<p>Human Resource Development</p>	<p>Colleges and Other Key HRD Institutions and Establishments; Research and R&D Human Resource Capacity.</p> <p>Indicators on the supply and demand of human resources in key technical, managerial and professional skill areas across all sectors.</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators to measure the extent of the improvements in the level of ICT Human Resource Capacity; Professional Level Human Resource Capacity in key Skill Areas; Human Resource Capacity and Levels in Key Sectors of the Economy: Agriculture, Services and Industry;</p> <p>Indicators to measure the extent of the improvements in the Human Resource Development Capacity of the Universities, Colleges and Other Key HRD Institutions and Establishment; Research and R&D Human Resource Capacity of the Nation.</p>
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<p>ICTAD Policy Pillar</p>	<p>Broad Types of Suitable Indicators</p>
<p>Promoting Universal Access and Service</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators of the spread of ICTs (computers, telecom network and services, Internet) within the society and community; the penetration of ICT services and resources within the community and society; the level and degree of exploitation of ICTs with the economy and society at large; the degree and level of deployment of ICT infrastructure and services in rural communities</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators to measure the extent of the spread of ICTs (computers, telecom network and services, Internet) within the society and community; the penetration of ICT services and resources within the community and society; the level and degree of exploitation of ICTs with the economy and society at large; the degree and level of deployment of ICT infrastructure and services in rural communities</p>
<p>Government Administration and Service Delivery – E-Government</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators on the degree and level of: the deployment and exploitation of ICTs as well as the deployment and implementation of e-government systems and initiatives within Government Ministries, Department, and Public Agencies and Establishments.</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators to measure the impact of the deployment and exploitation of ICTs and the implementation of e-government initiatives in Government and Public Sector Establishments on the efficiency, effectiveness, cost reduction and service delivery of these Agencies</p>

ICTAD Policy Pillar	Broad Types of Suitable Indicators
<p align="center">Promoting Electronic Commerce and the Development of the Private Sector</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators on the degree and level of the deployment and exploitation of ICTs within private sector organizations in the services, and industrial sector</p> <p>Indicators on the diffusion of ICTs and the Internet within the services, and industrial sector.</p> <p>Indicators on the extent of the development and production of ICT products (software development, computer and communication devices) and the provision of ICT services (telecom services, Internet services, web and content development services, ICT equipment maintenance and repair services etc) within the economy</p> <p>Indicators on the degree and the extent of the provision of e-commerce facilitation services (banking services, merchant services, fulfillment house services, etc)</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators to measure the volume of the value of e-commerce and e-trade services and transactions (locally and internationally)</p> <p>Indicators to measure the contribution of the ICT services sector and industry to economic growth, and to GDP and GNI</p>

ICTAD Policy Pillar	Broad Types of Suitable Indicators
<p>Developing Key Sectors of the Economy: Agriculture, Services and the ICT Industry</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators on the level of deployment and the degree of exploitation and utilization of ICTs within the key sectors of the economy: services, industry and agricultural sectors</p> <p>Indicators on the spread of ICTs within the key sectors of the economy: services, industry and agricultural sectors</p> <p>Indicators on the demand and supply of ICT-skills within the key sectors of the economy: services, industry and agricultural sectors</p> <p>Indicators on the level of ICT-related investment in key sectors of the economy: services, industry and agricultural sectors</p> <p>Indicators on the growth rate, productivity levels of each of the key sectors of the economy</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators to measure on a sector-by-sector basis the social, economic and infrastructural impact of the deployment and exploitation of ICTs within the</p>

	<p>key sectors of the economy: services, industry and agricultural sectors</p> <p>Indicators to measure the contribution of ICTs to growth and productivity within each of the key sectors of the economy: services, industry and agricultural sectors</p> <p>Indicators to measure the extend to which the deployment and exploitation of ICTs has contributed to growth and improvements in sectorial contribution to GDP and GNI</p> <p>Indicators to measure the overall impact of the development, deployment and the exploitation of ICTs within the economy on: investments, economic growth, agricultural, and industrial productivity and to GDP and GNI</p>
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ICTAD Policy Pillar	Broad Types of Suitable Indicators
<p>Promoting ICTs Deployment in Social Sectors: Education, Health, and Community</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators of the level of diffusion of ICTs (computers, Internet etc) within the educational, health sectors and in the community</p> <p>Indicators on the degree and level of utilization of ICTs within the social sectors: education, health and community</p> <p>Indicators to measure the degree of the deployment, penetration and the exploitation of ICTs to support teaching and learning in schools</p> <p>Indicators on community access and service delivery (rural vrs urban)</p> <p>Access and connectivity indicators on telecom and communication services including telephone and Internet services</p> <p>Indicators on the landscape of the deployment and exploitation of ICTs within the communities (rural vrs urban)</p> <p>Indicators on gender-related ICT access and usage statistics</p> <p>Indicators on the level of ICT expenditure and investment in the educational and health sectors</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators to measure the extent and the level of access to telecommunications and communications services within the social sectors of the economy</p> <p>Indicators to measure the level of community access and connectivity to ICT services and resources</p> <p>Indicators to measure the social and economic impact of ICTs households and communities</p> <p>Indicators to measure the social and economic impact of the deployment and exploitation of ICTs to support teaching and learning and research in the Universities and Colleges</p>

	<p>Indicators to measure the impact of the deployment of ICTs on educational, health and social services delivery</p> <p>Indicators to measure the modernization-coefficient of the educational institutions as a result of the deployment and exploitation of ICTs</p> <p>Indicators to measure the research and R&D output of higher educational institutions and research institutes</p> <p>Indicators to measure the extent of the deployment of ICTs within the community at large (rural vrs. urban)</p> <p>Indicators to measure the social and economic impact of the within and between communities and gender groups digital divide</p> <p>Indicators to measure of the level and the extent of ICT awareness in the society</p>
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ICTAD Policy Pillar	Broad Types of Suitable Indicators
<p>Promoting Research and Development</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Indicators to measure to research and R&D human resource base</p> <p>Indicators to measure national expenditure and investment in research and R&D</p> <p>Indicators on the volume and value of research and R&D output</p> <p>Indicators on ICT product and services development related research and R&D work</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Indicators to measure the contribution of research and R&D on economic growth, GDP and GNI</p>

ICTAD Policy Pillar	Broad Types of Suitable Indicators
<p>Legal, Regulatory and Institutional Framework and Environment</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Information on the existing legal and regulatory framework</p> <p>Information on types of cyber laws enacted</p> <p>Information on legislative instruments and provisions put in place to facilitate the ICT4D process in the country</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Information on the impact of the legal and regulatory regime on the ICT4D policy and plan implementation activities and initiatives within the country.</p>

ICTAD Policy Pillar	Broad Types of Suitable Indicators
<p align="center">National Security and Law and Order</p>	<p><u>Baseline/Readiness Indicators</u></p> <p>Information of e-security laws and provisions put in place to prevent and address cyber-crime related activities</p> <p>Indicators on the level deployment and exploitation of ICTs within the security agencies</p> <p>Indicators on the ICT skill base of the security agencies</p> <p><u>Impact Monitoring, Assessment and Measurement Indicators</u></p> <p>Information to measure the impact of the ICT deployment and exploitation within the economy and society on crime, law and order</p> <p>Indicators to measure the impact of the deployment and exploitation of ICTs within the security agencies on their operations and activities</p>

4.5 FRAMEWORK D: Classification of Indicators in terms of the Features of and Information and Knowledge Economy (IKE)

We in section 1 described the information and knowledge economy in terms of its key features [see Box 2]. Since the overall objective of the ICT4D process in most countries is to transform their respective economies and societies into an information and knowledge-based economies (IKE), it will be useful to develop indicators capable of monitoring, assessing and measuring the impact of ICT4D policy initiatives in terms of how far a given country is progressing towards this ultimate objective.

Based of the premise that each of the identified features of the IKE can be regarded as constituting a sub-goal to be achieved as a step towards the development of a given nation's information and knowledge-based economy, the proposed framework identify for each of these features a number of indicative indicators that can be used to measure progress towards the achievement of each of these sub-goals.

For example, a key characteristic or feature of an IKE has been identified as: *'A high income economy dominated by trading in ICT products and services'* can be translated into: *"A Goal to develop a high income economy dominated by trading in ICT products and services"*. Indicators to monitor, assess and measure progress towards the development of a *high income economy dominated by trading in ICT products and services*; becomes some of the candidate indicators that will need to be developed and integrated into the national statistical systems.

The proposed framework therefore provides a powerful methodological tool and system for developing suitable indicators for monitoring, assessing and measuring the impact of the ICT4D process in both developed and developing countries. The details of the framework are presented below involving identifying for each of the IKE development sub-goals (representing a feature of an IKE) a number of broad indicators that could be developed to monitor, assess and measure impact. The suggested list of indicators are indicative not exhaustive. Also identified for each of the sub-goals is the 'type of impact' (social, economic, infrastructural and institutional) as described in Table 1.

IKE Feature/Sub-Goal	Type of Impact	Indicative Broad Indicators for Measuring the Development of Information and Knowledge Economy (IKE)
A high income economy dominated by trading in ICT products and services	Economic	Indicators to monitor and measure economic growth, productivity (agric, industrial, services), GDP and GNI attributable to ICT4D initiatives
An economy characterized by a large commercial services sector with a reasonably large and vibrant ICT services sector and industry	Economic	Indicators to measure the contribution of the ICT production and services sector to economic growth, GDP and GNI Indicators to monitor and measure the size of the commercial services sub-sector activities
An economy characterized by a technology-based knowledge-driven industrial	Economic	Indicators to monitor and assess the knowledge-based activities of the industrial sector Indicators to monitor, assesses and measure the contribution of knowledge-based industrial sub-sector activities to economic growth, GDP and GNI
An economy with a globally competitive industrial and services sector which are to a large extent driven by cutting-edge R&D encompassing basic and applied industrial and product development.	Economic	Indicators to assess R&D expenditure per million of population Indicators to assess the impact of R&D on productivity in the industrial and services sector Indicators to measure the size of high tech exports attributable to R&D

Information and Knowledge Economy (IKE) Characteristics to Measure	Type of Impact	Indicative Broad Indicators for Measuring the Development of Information and Knowledge Economy (IKE)
<p>An economy based on a rich pool of highly skilled human resources in critical skill areas relevant for developing and maintaining a competitive edge on the global market</p>	<p>Economic + Social + Institutional</p>	<p>Human resource development indicators Indicators to measure the quality of human resources</p> <p>Indicators to assess the critical nature of various skills to the IKE</p> <p>Indicators to assess the critical mass requirement of various IKE skills</p>
<p>An economy in which the majority of the working population are either directly or indirectly involved in information and communications related activities</p>	<p>Economic + Social + Institutional</p>	<p>Indicators [Indexes] to measure the proportion of the working population involved in information and communication related activities of the economy</p> <p>Indicators to measure the gender composition of the working population involved in information and communication related activities of the economy</p>
<p>An economy with a modern, efficient and competitive agricultural sector</p>	<p>Economic</p>	<p>Indicators to measure the extent of mechanization of agricultural production activities</p> <p>Indicators to measure the extent of commercialization of agricultural activities</p> <p>Indicators to measure expenditure and investment on agricultural research and R&D</p> <p>Indicators on the degree of deployment and exploitation of ICTs to support agricultural activities (production, processing, distribution and marketing)</p>
<p>An economy characterized by a wide-spread deployment and exploitation of ICTs within the society to support the delivery of health, education, government and social services</p>	<p>Social + Institutional</p>	<p>Indicators to measure the extent of the deployment and the spread of ICTs within the community</p> <p>Indicators to monitor and measure the degree of deployment, and exploitation of ICTs within the Educational, and Health sector and institutions</p> <p>Indicators to monitor and measure the degree of adoption of ICTs to support operations and activities within government and public sector institutions</p> <p>Indicators to monitor and measure the degree of diffusion of ICTs within education, health and government institutions</p>

Information and Knowledge Economy (IKE) Characteristics to Measure	Type of Impact	Indicative Broad Indicators for Measuring the Development of Information and Knowledge Economy (IKE)
An economy characterized by a modern educational system within which ICTs are widely deployed to facilitate the delivery of educational services at all levels of the educational system	Social	<p>Indicators to measure the ICT adoption rate within the educational system</p> <p>Indicators to measure the degree of modernization within the educational system [Educational system modernization coefficients/indexes]</p>
An economy in which a reasonable large proportion of the population have access to information and communications technology products and services	Social + Economic+ Infrastructural	<p>Indicators to measure the contribution of ICT products and services sector to GDP, GNI</p> <p>Indicators to monitor and measure household expenditure on ICT products and services</p> <p>Indicators to capture changes in consumption patterns of households</p>
An economy in which the provision and delivery of goods and services of the key sectors of the economy are to a large extent facilitated by information and communications technologies	Economic + Infrastructural	<p>Indicators to measure the degree of the deployment of ICT infrastructure within the country</p> <p>Indicators to measure the level of Internet connectivity and usage within specific relevant sectors of the economy</p> <p>Indicators to assess the degree to which organizations and establishments within key sectors of the economy makes use of ICTs to facilitate the provision of services</p>
An economy based on an advanced and reliable national information and communications infrastructure	Economy + Infrastructural	<p>Indicators monitor and measure the level and the spread of ICT infrastructure</p> <p>Indicators to measure the spread and density of various information and communication technologies within the society and communities</p> <p>Indicators to measure the extent of the deployment of communications and network systems and technologies within organizations and indicator</p> <p>Indicators to measure the diffusion rate of ICT infrastructure within key sectors of the economy</p>

Information and Knowledge Economy (IKE) Characteristics to Measure	Type of Impact	Indicative Broad Indicators for Measuring the Development of Information and Knowledge Economy (IKE)
An economy based on a literate society with a high proportion of computer literates	Social	<p>Indicators to measure the ICT literacy within the society</p> <p>Indicators to measure the level and the spread computer awareness within the country</p> <p>Indicators to measure the degree of adoption computer education and training within the educational system</p> <p>Indicators on computer-related skills and professional within the workforce</p>

Conclusions

In this paper we made the case and established the need for the development of suitable ICT4D indicators to monitor and measure progress towards the development of the information and knowledge economy in both the development and developing countries. The paper also established the need to distinguish between baseline/e-readiness indicators and impact monitoring, assessment and measurement types of indicators. A number of methodological frameworks to guide the development of suitable indicators for integration into national statistical systems has been proposed and demonstrated.

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Annexes

Annex A: A Framework for Baseline Study on the Development, Deployment and Exploitation of ICTs

The objective of the Baseline Study Framework is to guide the compilation of relevant data on key ICT and socio-economic indicators within the economy and society to serve as a basis crystallizing ICT policy initiatives as well as for the projections and targets within ICT Plans. It is however worth pointing out that the aim of the study is not to conduct a comprehensive national survey within the economy and society but rather to carry-out a focused study concentrating on establishing the status of a number of key ICT-related indicators as they relate to key sectors of the economy.

1.0 THE ECONOMY

1.1 The ICT Industry/Sector

Description:

For the purpose of the Baseline Study, the ICT Industry/Sector refers to that sector of the economy involve in the provision (production, manufacturing, development, delivering or distribution) of ICT products and services. This industry consist of a number of sub-sectors including: (i) the production sub-sector of the economy involve in the production and assembly of ICT products (computers, telecom and communication equipment, office equipment, peripheral computer devices and parts etc), and the repair and maintenance of ICT equipment and systems (ii) the sub-sector involve in software and content development, distribution and support; and (ii) the sub-sector involve in the provision of ICT services including telecom, communication, Internet, and computer services.

Possible Sources of Information:

- ICT Product Manufacturers (TV, Computers, Office Equipment etc)
- Software and Content Developers (e.g. Software Houses, Web Hosting & Publishing Companies, Video Production and Recording Companies)
- *Telecom Service Providers*
 - Fixed Line
 - Mobile
- *Internet Service Providers (ISPs)*
- Print and Electronic Media Service Providers (TV Stations, Radio Stations, Print Media Publishers)
- ICT Product Suppliers/Vendors (TV, Computers, Software, Office Equipment,)
- Other ICT Service Providers (including those providing: Computer Network Services, Computer Secretarial & Office Services, Computer Maintenance and Repair Services, Software Support Services, ICT Consultancy Services, Electronic Equipment Repair Services, Cyber-Cafes, Telecenter Services, E-commerce Services, ICT-based Banking Services, Computer Training Centers, Fax & Telephone Kiosk Services, etc)

Key Indicators:

- Estimate of the Number of Business Establishments in each of the above Categories
 - Estimate of the Number of Local Companies and their Size (no. of staff) in each Category
 - Estimate of the Number of Foreign Companies and their Size (no. of staff) in each Category
 - Annual Turnover of Companies in each Category (on average)
 - Annual Export Earnings of Companies in each Category (on average)
 - Proportion of Staff recruited locally (average for companies in each category)
 - Proportion of Local Content/Input/Contribution of Products/Services (e.g. if a company sells imported computers/software/equipment then local content of product sold is zero, but if selling say computers assembled locally with all parts imported, then need to estimate local input in terms of labour/expertise for assembling the final product for the market)
- Estimate of the Size of the ICT Production and Service Sector in terms of:
- Number of People Employed in this Sector
 - Annual Turnover of the Sector
 - Investment Inflow via Foreign Direct Investment (FDI) into the Sector (annually)
 - Level of Domestic Investment in the Sector (annually)
 - Annual Sale of Locally produced ICT goods and services (e.g. computers, office equipment, software and services)

2.0 THE LEVEL OF ICT EXPLOITATION AND DEPLOYMENT IN KEY SECTORS OF THE ECONOMY

2.1 The Private Sector [Industry and Services]

Goal:

To establish the degree of ICT Exploitation and Development in the Private Sector with specific reference to the Industrial (Manufacturing and Cottage Industry) and Service Sectors.

Possible Sources of Information:

- *Manufacturing and Production Companies*
 - SMEs
 - Large Enterprises (LEs) and MNEs
 - Cottage Industries
- Service Sector Companies
 - SMEs
 - LEs and MNEs
 - Banks and Financial Institutions
- NGOs (Local, International)
- Others

Key Indicators:

For each of the above categories need to estimate based on a sample of companies within each category:

- Percentage and number of firms, that use ICTs by type of ICT (Internet,...); by type of sector (industry, services [banking, consulting, etc...]) and by size of firm (SMEs, LEs, MNEs)
- Degree of exploitation of ICTs to support organizational activities and operations
- Level of ICT Expenditure and Investment
- Level of R&D Expenditure
- Level and Types of ICT Outsourcing
- Level of ICT Social/Public Investment (in Schools, Colleges and Universities; Health Institutions, Social Welfare Establishments and Initiatives; NGOs)
- Level of ICT Training and Human Resource Development Expenditure
- Type of Computer Systems Installed (LANs, Stand-Alone Systems)
- Key Types of Applications and Usage of ICTs:
- Key Databases and Information Systems installed
- Level of Internet Connectivity and Spread Within the Companies
- Estimate of Percentage of Private Organization with Web-sites
- Types of Business use of the Internet:
 - Revenue generation
 - Customer service
 - Cost-saving
 - Marketing, and Business Promotion
 - Others
- Number and Category of ICT Personnel (System Managers, Programmers, System Analysts, Computer/Network Technicians, Software Developers/Engineers etc)
- ICT Personnel as Percent of Total Staff of the Organization
- Category of ICT Jobs Vacancies Not Filled

- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects within the Private Sector.

- Other Relevant Information and Indicators

2.1 The Private Sector [Agricultural Sector]

Goal:

To establish the degree of ICT Exploitation and Development in the Private Sector with specific reference to the Agricultural Sector

Possible Sources of Information:

- *Agricultural Institutions and Bodies*
- Farming and Fishery Organizations
- Farming Communities
- Others

Key Indicators:

For each of the above categories need to estimate (based on a representative sample of units):

- Percentage involve in the exploitation and deployment of ICTs to support their activities and operations

- Level of ICT Expenditure and Investment
- Level of R&D Expenditure
- Level of ICT Training and Human Resource Development Expenditure
- Key Types of Applications and Usage of ICTs:
- Key Databases and Information Systems in Use
- Level of Internet Connectivity and Spread
- Types of Business use of the Internet within the Sector:
 - Revenue generation
 - Customer service
 - Cost-saving
 - Marketing, and Business Promotion
 - Others
- Number and Category of ICT Personnel (System Managers, Programmers, System Analysts, Computer/Network Technicians, Software Developers/Engineers etc)
- ICT Personnel as Percent of Total Staff of the Organization
- A survey of the degree to which relevant and appropriate technologies and modern agricultural production methods are being introduced into the Sector at all levels
- A survey of the degree of commercialization within the Sector at all levels
- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects within the Agricultural Sector
- Other Relevant Information and Indicators

2.3 The Civil and Public Sector

Goal:

To establish the degree of utilization and deployment of ICTs in the Civil and Public Sector

To be Targeted:

- Government Ministries
- Other Public Sector Organizations

Key Indicators:

- Degree of exploitation of ICTs to support organizational activities and operations
- Estimate of Number of Computers in the Civil and Public Service
- Level of ICT Expenditure
- Level of ICT Training and Human Resource Development Expenditure
- Type of ICT Administrative Set-up (e.g. ICT Services Unit/Division/Directorate)
- Type of Systems Installed (LANs, Stand-Alone Systems)
- Key Types of Applications and Usage of Systems
- Key Databases and Information Systems installed
- Level of Internet Connectivity and Spread Within the Organization
- No. of Government Ministries and Public Sector Organisations Web-sites
- Typology of Government information on the Internet
- Number and Category of ICT Personnel (System Managers, Programmers, System Analysts, Computer/Network Technicians Software Developers/Engineers etc)
- ICT Personnel as Percent of Total Staff of the Organization
- Category of ICT Jobs Vacancies Not Filled

- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects within the Civil and Public Service.
- Other Relevant Information and Indicators

2.4 The Educational System

Goal:

To examine the extent to which ICTs are exploited and deployed within the Educational System

Possible Sources of Information:

- Primary Schools and Kindergartens
- Secondary, Technical and Vocational Schools
- Colleges and Universities

Key Indicators:

- Total No. and Percentage of Schools and Kindergartens with computers
- Total No. and Percentage of Schools and Kindergartens with Internet connectivity
- Total No. and Percentage of Universities and Colleges Depts with computers
- Total No. of Universities and Colleges Depts with Internet connectivity
- Geographical distribution of Schools/Universities and Colleges Depts with Internet connectivity and/ computers
- Computers/Students Ratio in the Schools, Colleges and Universities
- Type of Computer System installed (LAN, Stand-alone Computers)
- Typical Computer Applications
- What Computers are Used for (e.g. Support Admin, Teaching, Learning, Research)
- Level of Internet Connectivity and the Spread of Access
- Is there a SchoolNet Project (Primary and Sec. Schools)
- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects within the Educational System.
- Other Relevant Information and Indicators

2.5 Households

Goal: To examine the degree of exploitation and deployment of ICTs within the Households

Possible Sources of Information:

- Households

Key Indicators:

- Households with Computers
- Households with TVs
- Households with Radios
- Households with Telephones
- Households with Internet Connection

- Other Relevant Information and Indicators

2.6 The Health Delivery System

Goal:

To establish the level of exploitation and deployment of ICTs within the Health Delivery System

Possible Sources of Information:

- Clinics
- Health Posts and Centers
- Hospitals
- Medical Schools

Key Indicators:

- Percent of health institutions using ICTs (by type of health institution: private clinic, government, university hospital, etc and type of ICT)
- Geographic distribution of health institutions with computers, and Internet connectivity
- Level of ICT Utilization to Support activities and operations
- Principal purposes for the use of ICTs by health institutions:
 - e-mail
 - research
 - health promotion
 - health information
 - database applications
 - Software applications, etc...
- Level of Internet Connectivity, Exploitation and the Spread of Access
- Types of Telemedicine Applications Being Implemented if any?
- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects within the Health Delivery System
- Other Relevant Information and Indicators

2.7 Local Government Level

Goal:

To examine the degree of exploitation and deployment of ICTs within Establishments at the District and Province levels to Support the Delivery of Local Services

Possible Sources of Information:

- Local Government Administrative Services
- Health Delivery and Education Services
- Social Services
- Public Education and Information Services
- Economic Services
- Other Services

Key Indicators:

:

- To what extent are ICTs used to support the delivery of the above services at the district and province levels.
- The level of use of the Internet in the local government institutions to support their activities and operations
- The extent to which rural development initiatives are supported by the exploitation and deployment of ICTs
- Human Resource Development efforts at district and province levels
- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects at the Local Government Level.
- Other Relevant Information and Indicators

3.0 ICT EDUCATION, TRAINING AND HUMAN RESOURCE DEVELOPMENT CAPACITY

3.1 ICT-Related Education and Training

Goal: To examine and establish the extent to which ICTs are being exploited and deployed to facilitate education and training efforts within the country.

Possible Sources of Information:

- Primary Schools and Kindergartens
- Secondary, Technical and Vocational Schools
- Colleges and Universities
- Private Computer Training Centers

Key Indicators:

- The extent to which Computer Curriculum are being Developed and Taught in Schools
- The Deployment of Computer Literacy Teachers in Schools
- The Implementation of SchoolNet Systems in the Schools
- Number of Schools having “Computers-in-Schools” Programme
- Types of Computer Courses and Levels (Colleges and Universities)
- The level and the extent of exploitation and deployment of Computers to support teaching, learning and research in various University/College Departments
- The extent to which Computer Studies (as a basic requirement course) is being taught in various University/College Departments.
- Annual ICT Graduate Output on each Programme (Cert, Diploma, Degree)
- Projected Annual Graduate Output for all Programmes in the next 5 years
- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects Related to Education and Training Provision within the Country.

- Other Relevant Information and Indicators

3.2 ICT Human Resource Development in the Private Sector

Goal:

The Goal of the Baseline Study in this area is to:

- Establish the extent to which the Private Sector is involved in Human Resource Development in Key Skill Areas and
- Estimate the Human Resource Development Requirements of the Private Sector

Possible Sources of Information:

- *Manufacturing and Production Companies*
 - SMEs
 - LEs and MNEs
- Service Sector Companies
 - SMEs
 - LEs and MNEs
 - Banks and Financial Institutions
- NGOs (Local, International)
- Others

Key Indicators:

- In-company Human Resource Development Initiatives
- Short-term Training Programme for Staff in Private Sector Establishments
- Other Staff Development Programmes
- Level of Support for Human Resource Development in Institutions (Schools, Colleges and University)
- Level of Human Resource Development Expenditure
- Level of R&D Support Activities in ICTs and Other Areas
- Estimate of Shortfall in Key Skill Areas (e.g. ICT, Management, Engineering, Accountancy, Business, Technicians etc)
- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects related to Human Resource Development in the Private Sector.
- Other Relevant Information and Indicators

3.3 ICT Human Resource Development in the Civil and Public Service

Goal:

To establish the Human Resource Development Needs of the Public Sector

Possible Sources of Information:

- The Ministries
- Other Public Sector Organizations

Key Indicators:

- The level of ICT Skill development and upgrade within the civil and public service.
- Programme to improve the management, policy formulation, planning, execution and monitoring skill within the civil and public service
- Level of Human Resource Development Expenditure in the Civil and Public Service
- Survey of Key Human Resource Requirements of the Civil and Public Service
- Estimate of Shortfall in Key Skill Areas within the Civil and Public Service
- Survey of On-going ICT Exploitation, Deployment or Development Initiatives and Projects related to Human Resource Development in the Civil and Public Service.
- Other Relevant Information and Indicators

4.0 EMPLOYMENT LEVELS AND THE SUPPLY OF ICT AND OTHER RELATED SKILLS

4.1 The Employment Levels of ICT-related Skills

Category of Skills

- Programmers
- Software Developers/Engineers
- System Analysts
- Information System Specialist and Documentalists
- System Managers
- Computer Scientist (University Degree)
- Computer Technicians
- Computer Engineers
- Electronic and Electrical Engineer
- Telecommunication Technicians
- Telecommunication Engineers
- Managers of ICT-related Companies/Establishments
- Computer Trainers (Basic Level)
- Computer Teachers (in Schools)
- Computer Lecturers and Professors (Universities)
- Service Sector Professional Skills
 - Banking and Financial Services
 - Accountants
 - Lawyers
 - Others

Key Indicators:

- Total employed in all sectors
- Unfilled Vacancies (Shortfall)
- Average Salary Levels

- Academic Qualifications/Educational Level (on average)
- Where the Majority Were Trained (Home or Abroad)
- Average Age Group of People with Key Skills
- Proportion of locally recruited Staff in each Category (on average)
- Common Method of Acquiring Expertise (e.g. Education at an Institution; On-the-Job Training or by Apprenticeship)
- Other Relevant Information and Indicators

4.2 The Supply ICT-related Skills

Category of Skills

- Programmers
- Software Developers/Engineers
- System Analysts
- Information System Specialist and Documentalists
- System Managers
- Computer Scientist (University Degree)
- Computer Technicians
- Computer Engineers
- Electronic and Electrical Engineer
- Telecommunication Technicians
- Telecommunication Engineers
- Managers of ICT-related Companies/Establishments
- Computer Trainers (Basic Level)
- Computer Teachers (in Schools)
- Computer Lecturers and Professors (Universities)
- Service Sector Professional Skills
 - Banking and Financial Services
 - Accountants
 - Lawyers
 - Others

Key Indicators:

- Total number in the country
- The National Pool of University Graduates in Key Skill Areas
- Annual Output of Graduates from the Colleges and Universities in Key Skill Areas
- Academic Qualifications/Educational Level (on average)
- Where the Majority Were Trained (Home or Abroad)
- Average Age Group of People with Key Skills
- Common Method of Acquiring Expertise (e.g. Education at an Institution; On-the-Job Training or by Apprenticeship)
- Estimate of the 'Brain Drain' annually in key Skill Areas
- Estimate of People trained in Basic Computing by Public and Private Computer Training Centers in the country
- Other Relevant Information and Indicators

4.3 Annual and Projected Output of ICT-related Graduates from the Colleges and Universities

Category:

- Programmers
- Software Developers/Engineers
- System Analysts
- System Managers
- Computer Scientist
- Computer Technicians
- Computer Engineers
- Electronic and Electrical Engineer
- Telecommunication Technicians
- Telecommunication Engineers
- Computer Trainers (Basic Level)
- Computer Teachers (in Schools)

Key Indicators:

- Annual Output per qualification (e.g. certificate, diploma, degree level)
- Projected Annual Output for the next 5 years per qualification (e.g. certificate, diploma, degree level)
- Other Relevant Information and Indicators

5.0 THE ICT INFRASTRUCTURE

5.1 Physical Infrastructure

Key Information and Indicators:

Specific details relating to the state or the current capacity/resources of the following key physical infrastructures including: (i) on-going projects to rehabilitate, the next 5 years

- Transport (Land, Air, Sea)
- Electricity
- Water

5.2 Telecommunications and Internet Infrastructure

Key Indicators:

- Fixed Line Telecom: Current Capacity/Supply, Demand and Capacity Projections

- Mobile: Current Capacity/Supply, Demand and Capacity Projections
- Number of Telephone Subscribers (Fixed Line) and Projections
- Number of Telephone Subscribers (Mobile) and Projections
- The Teledensity (National; Urban vrs. Rural)
- Projected Teledensity (National; Urban vrs. Rural)
- International Internet Bandwidth (Current and Projections)
- Other Relevant Information and Indicators

5.3 Communications and the Mass Media Infrastructure

Key Indicators:

- Number of Daily/Weekly Newspapers
- TV Stations and the Level of Spread of Services
- Number of Radio/FM/Community-Based Stations and the Level of Spread of Services
- Number of Radio Stations Broadcasting on the Internet
- Other Relevant Information and Indicators

6.0 OTHER RELEVANT SUBJECT AREAS TO BE INCLUDED IN THE STUDY

- The Economy (focusing on key socio-economic indicators)
- The level of ICT exploitation, deployment in key sectors of the economy including the:
 - Private Sector
 - Civil and Public Service
 - Agricultural Sector
 - Industrial Sector
 - Service Sector
 - Education, Health Sectors etc
- Human resource development capacity
- Employment levels in key relevant sectors
- Demand and supply of ICT-related skills within the country
- The ICT Infrastructure with specific reference to the:
 - Physical Infrastructure (Transport, Electricity etc.)
 - Telecommunications and Internet Infrastructure
 - Communications and the Mass Media Infrastructure
- Others

Annex B: The Scan-ICT METHODOLOGY AND TOPOLOGY

The ICT Infrastructure Indicators

Transport
<ul style="list-style-type: none"> <input type="checkbox"/> Roads Network <input type="checkbox"/> Railways Network <input type="checkbox"/> Water Transportation System <input type="checkbox"/> Air Transport
Telephone
Teledensity statistics (including average number of people per telephone)
Geographic proximity to a telephone, i.e. +/- 5kms or walking distance (Total and %)
Telephone communication charges: Average cost distributed be either local, international, business and domestic, differential (USD and % of GDP per capita)
Telephone connectivity: mapping and distribution (by government, private sector, international orgs, NGOs, rural vs. urban, age and sex; and by domestic, business or public access)
Average duration of Telephone usage per year
Failure rate
Time to repair
Telecenters
Description & Topology
Number of telecenters (Total and % of total and per 1000)
Telecenter phone charges
Operators
Number of operators (long distance; local; mobile)
Flow of traffic
Ratio of incoming/outgoing international calls
Ratio of local calls to international
Mobile phone
Mobile phone subscribers (Total and %; total and % of total subscribers that are pre-paid phone card users)
: Mobile communication charges; average mobile hand-set ¹ cost
Mobile connectivity: mapping and distribution by: Govt, private sector, international orgs, NGOs, other sectors; rural vs. urban; age and sex

¹ Mobile handset defined as lowest cost for a brand-name phone.

The Internet-related Indicators [Usage, Access and Service Providers etc]

Internet users
Internet users (Total and per 1000)
Geographic proximity to an Internet connection, i.e. +/- 5kms or walking distance (Total and per 1000)
Internet Connectivity
Internet connectivity distribution (mapping and statistics):
<input type="checkbox"/> Government, private sector, international orgs, NGOs, other sectors
<input type="checkbox"/> Geography (rural vs. urban, etc.)
<input type="checkbox"/> age and sex
<input type="checkbox"/> domestic, business, public
Internet Bandwidth (average bandwidth to the ISP and long haul bandwidth from the ISP to the Internet backbone)
Local Internet Content
Local Internet hosts and web-sites (Total and % of population)
Local ISPs
Number of ISPs (Total)
Internet access charges
Internet access charges (as % of GDP per capita and in nominal USD terms)
Telecenter Internet charges (as % of GDP per capita and in nominal USD terms)
Break-down of costs by telephone charge, computer use, and service charges
Internet Usage
Home vs. work usage and access (ratio of domestic users to business users)
Use of the Internet: e-mail, Web access, Teleconference, FTP, Others

ICT Devices, Equipment and Resources Indicators

Computers (Stock, Cost & Usage)
Number of Computers (total and % of population)
Average retail cost (as % of GDP per capita and in nominal USD terms (before and after duty and taxes))
Ratio Home to work usage
TV stock Cost & Channels
Number of TV sets (total and % of population)
Average costs of TV sets ² (Nominal USD and % of GDP per capita (before and after duty and taxes))
Number and type of channels and local broadcasters (public or private, etc.)
<i>TV and cable distribution and access</i>
Geographic distribution/ accessibility (total area served):
<input type="checkbox"/> TV sets (Mapping and statistics) <input type="checkbox"/> Cable/satellite (Mapping and statistics) <input type="checkbox"/> Distribution rural/urban <input type="checkbox"/> % of population served <input type="checkbox"/> Age and sex distribution
Radio: Stock, Cost & Content
Number of Radios (Total and % of pop)
<input type="checkbox"/> Geographic dissemination of local frequencies (Mapping and statistics) <input type="checkbox"/> Local Channels/ broadcasters (Number and type (public or private; urban or rural))
Average cost ³ of radio (nominal USD and % of GDP per capita)

B- Legal and Regulatory Environment Indicators

National Legislation Concerning ICTs
<input type="checkbox"/> Licensing regime <input type="checkbox"/> Services subject to licensing <input type="checkbox"/> Fiscal regime applicable to ICTs <input type="checkbox"/> Status of the incumbent operator <input type="checkbox"/> Level of competition <input type="checkbox"/> Universal service obligations <input type="checkbox"/> Mechanisms for financing of universal service obligations <input type="checkbox"/> Tools for effective regulation (existence of a regulatory authority, enforcement power, independence, financing of the RA through license/numbering/spectrum fees, transparency, dispute resolution mechanisms)

² Average TV set is defined as a 20 inch, brand name TV

³ Average radio defined as lowest cost multi-band brand name radio.

ICT Human Resource and Capacity Development Indicators

Labor market in general
Emigration and immigration statistics (total and %)
Current and future trends in the labour market
Unemployment rate
% Sectoral & gender distribution (service-industry-agriculture)
ICT professionals and the ICT labor market
Definition and typology
Geographic, gender and age distribution of ICT professionals
Description of ICT professional associations
Support for ICT human resource development
National structures to Support ICT human resource development
Number of universities and colleges offering computer science programs and courses
Number of private computer training institutes providing basic computing, advanced, certificate or diploma
Level of in-company training and skill upgrading services
Degree of incorporation of computing courses in the university curriculum
Supply and demand of ICT skills
<i>Supply: International recruitment & Length of service</i>
Total number of internationally recruited ICT professionals and % of total ICT workforce (gender distribution)
Average length of service ICT workers (Length in years (gender distribution))
<i>Supply: Availability</i>
Pool of ICT graduates (gender distribution)
Number of graduates per year (gender distribution)
Emigration of ICT professionals (distribution)
Type of skills (programmers, software developers, system analysts, system managers, computer scientists, telecommunications specialists, trainers, service sector profession skills, etc) and annual output per qualification
<i>Demand : Employment levels in the ICT industry</i>
Current level of Employment in the ICT industry (in absolute terms and % of total workforce (gender distribution))
<i>Current and Forecast Supply and demand trends</i>
Baseline survey of IT firms, NGOs and government
Remuneration
<i>Salaries</i>
Salary for ICT professionals by type of ICT employment (software, hardware, consulting, etc.) (Annual average salary rates (USD))
Distribution of salary rates by private, NGO and government sectors
Gender distribution
<i>Retention strategies</i>
Type of retention strategies (stock options, benefits in-kind, continuous training, etc)

Sectoral Application Indicators

Education

ICT Penetration
Total and % of schools with computers (distributed by primary and secondary school)
Total and % of schools with Internet connectivity (distributed by primary and sec. schools)
Total and % of colleges and universities with computers (distributed by dept when possible)
Geographic distribution of schools (all types) with connectivity and/or computers
ICT Investments
Level of ICT investments and expenditures in the educational sector (total and distribution by type of institutions; USD and % GDP)
Users
Percentage of students (sub-divided by educational establishment type (i.e., primary school, secondary, university, etc) that have used or use computers and/or the Internet and those that have used it for educational purposes
Percentage of teachers or professors that use the Internet and/or computers and those that have used it for research or academic purposes, gender distribution
Usage/Access
Where do students/teachers get access to computers or the Internet? (% of students/teachers that get access to computers and/or Internet through (distributed by age and gender): School, Telecentres, Household)
For what purpose do students/teachers use computers/Internet (E-mail, Research, Employment opportunities, Application software, etc)
Is usage free, if not, is cost an obstacle?
Content (Internet, Computers)
Availability of local education content (Number and % of schools/universities that use locally made educational content and number of web-sites that have educational content)
Availability and source of distance learning
Availability of TV or radio educational programs
Principal languages of educational content (% in local languages)
Educational Management Information Systems
Number of universities using EMIS
Number of schools using EMIS
Degree of use of ICTs to support the activities of the Ministry of Education (and related departments)
Non-formal education
Use of computers/Internet in non-formal education programs (compared to formal education)

Culture

ICT penetration, investments and spending
Number of cultural institutions (Museums, Art galleries, art councils, archives, theatre etc) that use ICTs
Level of ICT investments and expenditures in the cultural sector (total and distribution by type of institutions;% GDP)
Local content
Typology of local Internet web-sites

Number and % of local web-sites with local cultural information and % in local languages
Types of institutions that support the creation and provision of content like radio, academic libraries and museums

Health

ICT Penetration
Percentage of health institutions using ICTs (by type of health institution: private clinic, government, university hospital, pharmacy etc and type of ICT)
Geographic distribution of health institutions with computers, telephone and Internet connectivity
<i>ICT investments and spending</i>
Level of ICT investments and expenditures in the health sector (total and distribution by type of institutions; USD and % GDP)
Users, Usage and Content
Percentage of doctors that use ICTs for medical purposes (research, tele-medicine, e-mail, etc) by type of ICT (computer, Internet)
Percentage of population that have used or use the Internet for health information
Principal purposes for the use of ICTs by health institutions:
<input type="checkbox"/> tele-medicine <input type="checkbox"/> e-mail <input type="checkbox"/> research (health information, etc) <input type="checkbox"/> continuing medical education or distance learning <input type="checkbox"/> health promotion <input type="checkbox"/> including health information systems <input type="checkbox"/> database <input type="checkbox"/> Software applications
Content:
<input type="checkbox"/> number of local web-sites with medical information <input type="checkbox"/> availability of local language health info. (with typology)

Natural Resource and Land Management (Environment)

<i>ICT penetration, investments and spending, Usage & Content</i>
Number of institutions in the area of NRM that use ICTs (by type of ICT) for the purpose of NRM
Level of ICT investments and expenditures in the NRM sector (total and distribution by type of institutions; USD and % GDP)
Principal purposes for the use of ICTs in NRM: geomatics, early warning systems, research etc
Content:
<input type="checkbox"/> % of local web-sites with NRM/env. Information <input type="checkbox"/> typology of environmental information content

Public Institutions- E-Government Applications

ICT penetration, investments and spending, Usage & Content
<input type="checkbox"/> total and % of government departments that have access to ICTs (by type of ICT and department) <input type="checkbox"/> type of system installed (LAN, stand-alone, etc)
Level of ICT investments and expenditures in the government sector (total and distribution by type of institutions; USD and % GDP)
<input type="checkbox"/> % of government workers that use ICTs (by type of ICT) <input type="checkbox"/> Distribution of Internet users by government department and bureaucratic category <input type="checkbox"/> ICT personnel as a % of the total personnel <input type="checkbox"/> Level of ICT literacy <input type="checkbox"/> Distribution of computers and/or Internet by gender and age
Purpose of use ICTs: e-mail, research, database work, geomatics, Application software
Availability of government information and applications on the Internet
<input type="checkbox"/> Number of government departments with web-sites (existence of a portal site?) <input type="checkbox"/> Typology of government information on the Internet <input type="checkbox"/> Typology of public service functions (income tax, car registration, voting., etc) that can be done using the Internet.

Agriculture

<i>ICT penetration, investments and spending, Usage & Content</i>
Percentage involved in the exploitation and deployment of ICTs to the sector
<input type="checkbox"/> Level of ICT investments and expenditures in the agricultural sector (total and distribution by type of usage; USD and % GDP) <input type="checkbox"/> Level of IT Training expenditures
<input type="checkbox"/> Percentage of ICT users (level of connectivity and spread) <input type="checkbox"/> Level of ICT awareness (including Internet information sites on agriculture or weather) <input type="checkbox"/> Number and category of IT personnel
<input type="checkbox"/> Typology of usage of ICTs in the agricultural sector (R&D, business, weather, prices, etc)
<input type="checkbox"/> Number of Local web-sites with agricultural information and content (or web-sites with local information on agriculture) <input type="checkbox"/> Key databases and information systems in use

The Information Economy Indicators

Overview of the ICT industry
Composition and definition of the ICT industry (Telecom, Hardware, software, etc)
Total market capitalization, revenue, employees,
% of GDP
Turnover and profitability, revenue earned, growth rates (international and national)
<i>ICT Players</i>
Ownership structure (i.e. state or private), revenues , profits, market capitalization, market share, growth (forecast) and number of employees for each company in each sector:
<input type="checkbox"/> Hardware

<input type="checkbox"/> Telecom <input type="checkbox"/> Software <input type="checkbox"/> Professional services
Hardware sector
Mainframe, midrange and PC installed base
Computer hardware sales, revenues, profitability, growth rates
R&D spending
Total employees
Software sector
Sales, revenues, profitability, growth rates
Software sales by software type
Sales of locally developed software type
Total employees
Telecommunications (hardware and operator) sector
Sales, revenues, profitability, growth rates
Structure (mobile, landlines, cable, etc)
Total employees
Degree of competition in the different services (local, long distance, international, leased lines, mobile)
Professional services (consulting, etc) sector
Sales, revenues, profitability, growth rates,
Typology of services offered

Informal ICT Sector

Overview, Usage & Actors
Number of people involved and % of total workforce
Revenues generated (USD) and % of GDP and % of ICT formal sector
Type of informal section uses of ICTs (mobile telephony sub-contracting; pirate VSATs, etc)
Actors: Typology of Informal sector (typology and distribution by sex and age)

E-Commerce

Overview
Availability of e-commerce portals (centers):
<input type="checkbox"/> EC-DC <input type="checkbox"/> Trade points, etc
E-commerce revenues, including projections (USD)
<input type="checkbox"/> Business to business <input type="checkbox"/> Business to consumer
Value of on-line transactions, with projections
Top 10 e-commerce sites (with description)
Geographic distribution of e-commerce activity
Value of “imports” and “exports” through the use of e-commerce

Users, Usage & Content

Typology of transactions (type of products or services offered)
Typology of usage (teleservices, etc)
Number and % of consumers who have used e-commerce (or plan to)
% of local web-sites that are used for e-commerce

ICTs and the Commercial Sector (E-Business)

ICT penetration

Percentage and number of firms that use ICTs, notably the Internet; by type of sector (agriculture, industry, services [banking, consulting, etc]) and by size of firm (SMEs, LE, MNE)
Percentage and number of firms that have a web-site
Percentage of expenses on investments in ICTs

Usage

Purpose of the use of ICTs: e-mail, e-commerce; Internet research (marketing intelligence, partnerships, distribution or client searches, etc...), Software applications
Business use of the internet: <input type="checkbox"/> Revenue generation <input type="checkbox"/> Customer service <input type="checkbox"/> Cost-saving <input type="checkbox"/> Marketing, etc...
-Types of Internet Information sought: <input type="checkbox"/> Technical and computer <input type="checkbox"/> General <input type="checkbox"/> Financial market <input type="checkbox"/> Economic and government <input type="checkbox"/> Supplier, etc