Development of a Multi-Factor Set of Country-Level ICT Human Resource Capacity Indicators

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Abstract

In an effort to measure and bridge the digital divide, several different types of indicators have been developed to measure the readiness of a country to adopt information and communication technology (ICT). Many of these indicators measure the extent to which the technology has been adopted within the target population. While some indicators recognize the importance of computer skills and e-literacy, there has been minimal effort to develop a multi-factor set of indicators to measure ICT human resource capacity. In this paper, we draw upon prior work on ICT indicators to develop eight sets of ICT human resource capacity indicators, including human capacity of ICT specialists, advanced users, basic users, ICT enabling managers, ICT equipped educators, thought leaders, policy makers, and infrastructure builders. Drawing extensively upon measurement indices that have been endorsed by major international development agencies, we propose specific questions to measure our ICT human resource capacity indicators. Since each country has different needs in developing the eight types of ICT human resources, we believe that collecting the proposed data will help in producing more effective training programs to meet the needs of specific countries.

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1. INTRODUCTION

Research has shown that an important factor contributing to the digital divide is the level of education and computer skills that influence a person's ability to know about, learn how to use, and subsequently make effective use of information and communication technology (ICT) [Robinson, et al. 2003]. These authors also point out that simply having access to ICTs is not sufficient, since there also exists a second order digital divide in how people actually make use of the technology. This idea was further developed by Dewan and Riggins [2005] who recommend that research be conducted on how policy makers can best promote the skills that are complementary to the productive usage of ICT.

The need to promote such skills, or ICT human resource capacity, within a society is one of the primary goals of policy makers seeking to bridge the divide and create a modern information society. Indeed, ICT human resource capacity can be considered an essential part of the "infrastructure" needed to encourage ICT usage and e-development. Toward this end, developing ICT human resource capacity is necessary for supplying important skills and resources to a developing ICT industry sector, encouraging foreign direct investment when it is known that a ready supply of employee talent is available, encouraging the development of entrepreneurial enterprises and other small and medium sized enterprises (SMEs) in an advancing information society, and providing important e-development initiatives such as e-government, e-democracy, and e-medicine. Therefore developing ICT human resource capacity is an important part of fostering socio-economic development and achievement of the Millennium Development Goals (MDGs) as put forth by the United Nations.

Policy makers in many countries are recognizing these assertions. For example, the government of Brunei recently announced a long-term InfoComm Competency Training Programme under the direction of the Authority for Info-communication Technology Industry Brunei (AiTi) to advance ICT skills and knowledge among the Brunei workforce [Othman, 2006]. The program will be aimed at developing a number of certified ICT consultants, provide training to government workers as they develop e-government initiatives, upgrade ICT skills of SME employees, and empower unemployed workers with basic ICT skills. The programme will focus on both technical and interpersonal ICT skills that are applicable in various industry sectors.

Several international agencies are also seeking to promote ICT human capacity development. Some examples include the ITU which seeks to develop ICT human resource capacity through its Telecommunications Development Bureau [ITU, 2006], the UNDP's Asia-Pacific Development Information Programme (APDIP), and the Asia Pacific Telecommunity (APT) programme. Recently, the Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) was launched under UNESCAP in 2006 to (1) provide training for policy makers, ICT professionals and ICT trainers, (2) provide ICT advisory services to governments, and (3) conduct research on ICT human resource capacity development. These and other examples illustrate the increasing level of international cooperation in developing systematic measurement capabilities as development agencies seek answers to the digital divide.

Unfortunately, there are many obstacles to overcome in developing ICT human resource capacity. Many primary, secondary, and even tertiary schools in developing

countries lack computer technology resources or even the basic infrastructure needed to implement computer technology. A recent government survey in Sri Lanka indicates that only 32.5 percent of Sri Lanka's teachers possess computer literacy skills that are necessary to teach in a modern teaching environment, and that only 17 percent of the nearly 9,000 schools had computer labs of any sort [Ratnayake, 2007]. Further, slightly more than half of the teachers have computer "awareness" meaning they use at least one computer for one purpose. To help the situation, the Ministry of Education in Sri Lanka hopes to expand the number of centers that will teach ICT skills to teachers.

While many countries lack the most basic ICT human resource skills, another obstacle is the speed with which expertise and skills can become outdated in today's fast-paced technology environment. Recent figures released from the Human Resources Ministry of Malaysia indicate that the majority of the 20,217 registered unemployed graduates have taken a tertiary-level ICT course [ICT in Education, 2006]. However, much of what they learned is now obsolete due to rapidly changing technology, the inability of ICT training centres to keep their curriculum current, and the cost of offering high-end ICT courses. Rather than simply teaching word processing and basic computer literacy, employers are seeking highly skilled graduates for server maintenance, connectivity management, and web page design. The Human Resources Ministry states that many employers are seeking graduates of certified professional software development courses. These types of skills require vigilance to keep up-to-date on the part of the learner and the educator.

In a recent UNESCAP report, Raina [2007] estimates that the total demand for ICT workers within the ICT industry sector for the Asia Pacific region will increase from

11.2 million in 2007 to 16.9 million in 2010 – a 50% increase in three years. Further, he estimates that ICT workforce demand the region within user sectors that are outside the ICT industry will increase from 41 million in 2007 to 73.4 million in 2010 – nearly an 80% increase. Clearly as the economic growth of the region continues the high need for technically skilled workers will continue to increase dramatically. It would seem that countries that are not able to keep up with the demand for such skills may fall further behind in economic development.

Despite the fact that there are a number of efforts underway to develop ICT skills and human resources, there are no reliable indicators to measure a country's ICT human resource capacity. As government policy makers seek to keep up with the needs of developing an ICT-literate population with adequate skills for today's information economy there is a need for better ways to measure a country's ICT human resource capacity. In this paper, we develop and propose eight sets of ICT human resource capacity indicators that can be used for comparative and benchmarking purposes. We believe these indicators will be helpful in developing ICT training programs and can be used by policy makers to assess their progress in developing ICT human resource capacity over time.

2. PRIOR EFFORTS TO DEVELOP ICT INDICATORS

Over the past decade there have been a variety of attempts at developing indicators to measure the extent and impact of the digital divide. Some of these indicators attempt to measure the e-readiness of a country or region. For example, Wolcott et al. [2001] have developed an e-readiness measure of Internet adoption and

usage by countries. Their metric is based on six factors: pervasiveness, sophistication of use, geographic dispersion, sectoral absorption, organizational infrastructure, and connectivity infrastructure. While sophistication of use measures the extent to which this technology has been used in a transformational nature throughout the country and sectoral absorption measures the extent to which the Internet is used in various academic and other types of institutions, none of these factors measure the ICT human resource capacity of a country.

Since 2000, the Economist E-Readiness Ranking [EIU, 2006] has been a commonly used index to measure the e-readiness of a country. This index consists of nearly 100 quantitative and qualitative criteria organized into six categories including connectivity and technology infrastructure (25% weighting), business environment (20%), consumer and business adoption (20%), social and cultural environment (15%), legal and policy environment (15%), and supporting e-services (5%). Of these, the social and cultural environment index measures the "e-literacy" of the population by considering the population's experience with using the Internet, the receptivity of the population to the technology, and the technical skills of the workforce.

Bridges.org provides a useful comparison summary of a variety of ICT indicators and approaches to measuring e-readiness [Bridges.org, 2005]. They break down the various tools used into the following categories:

1. Ready-to-use tools – questionnaires
   Examples include Harvard University's Center for International Development (CID)'s *Readiness for the Networked World: A Guide for Developing Countries*, Asian Pacific Economic Cooperation's (APEC)'s *E-Commerce Readiness Assessment*, and the Computer System Policy Project (CSPP)'s *Readiness Guide for Living in the Networked World*.

2. Case studies
   Examples include the International Telecommunications Union's (ITU)'s *Internet Country Case Studies*, the ASEAN e-readiness assessments, and those by USAID, *info*Dev, and SIDA.
3. Third party surveys and reports
   There are a variety of studies using third party data.
4. Other e-readiness assessment models
   There are a variety of reports and models that seek to measure the digital divide in various ways.

Harvard's assessment tool examines a society's "readiness for the networked world" and is part of the Harvard University's Center for International Development (CID) Readiness for the Networked World program.[1] This guide measures a region for ICT readiness using 19 different categories under five groupings including access, learning, society, economy, and policy. Under the category of "learning" they assess three different areas: 1) schools' access to ICTs, 2) enhancing education with ICTs, and 3) developing the ICT workplace. The approach used in this assessment is to allow the respondent to select from a series of stage descriptions that best describes the current status of the country or region. This subjective approach introduces certain biases into the data collection process, however, it is a simple and relatively straightforward way for a policy maker to assess where his or her region is compared to other benchmarks. It also provides the respondent with a set of criteria to use in attempts to develop programmes to advance ICT readiness.

A report by the RAND Corporation showed that in a number of case examples studied, collaboration on science and technology (S&T) projects between "scientifically advanced countries" (SACs) with "scientifically lagging countries" (SACs) has a positive impact on capacity building in the lagging countries [Wagner, et al., 2001]. To do this

[1] Harvard University's Center for International Development (CID) Readiness for the Networked World: A guide for developing countries, see http://cyber.law.harvard.edu/readinessguide/.

study, the authors created a composite S&T capacity index of 150 countries. The index was created as a weighted measure of the following factors:

- The per capital gross national product (GNP) of the country to serve as a proxy for general infrastructure,
- The number of scientists and engineers per million people to capture the human resources available for S&T activities,
- The number of S&T journal articles and patents produced by citizens of the nation to characterize S&T outputs,
- The percentage of GNP spent on R&D to measure the society's level of input into S&T,
- The number of universities and research institutions in the nation per million people to characterize the infrastructure for S&T,
- A measure of the number of the nation's students studying in the United States adjusted for those who chose not to return home at the conclusion of their studies to characterize the country's contact with external knowledge sources, and
- The number of patents filed through the U.S. Patent and Trademark Office (USPTO) and the European Patent Office (EPO).

While not specifically measuring ICT human resource capacity, these factors provide a useful way to measure issues related to intellectual property capacity and knowledge creation.

In 2002 the Asia-Pacific Economic Commission (APEC) published a paper on "E-Commerce Readiness" which used an evaluation tool based on 52 different categories [Bui, et al. 2002]. Of these, the following categories are somewhat related to ICT human resource capacity:

- overall education levels including adult literacy rate, secondary enrollment, tertiary enrollment,
- science literacy based on eighth grade achievement in science,
- management education as to whether or not management education is available in first-class business schools,
- the Technology Achievement Index (TAI) from the United Nations Development Programme (UNDP), and
- the gross tertiary science and engineering enrollment ratio.

However, none of these categories actually attempts to measure ICT human resource capacity specifically.

The UNDP's Technology Achievement Index (TAI) "… aims to capture how well a country is creating and diffusing technology and building a human skill base – reflecting the capacity to participate in the technological innovations of the network age" [UNDP, 2001, p. 46]. A key component of the TAI relates to "human skills" which attempts to capture the skills of creators and users of new technologies. The two indicators used are "mean years of schooling" and "gross enrollment ratio of tertiary students enrolled in science, mathematics and engineering." The report states that "though it would be desirable to include indicators of vocational training, these data are not available" [UNDP, 2001, p. 46].

The Organisation for Economic Co-operation and Development (OECD) has developed a list of 15 "Key ICT Indicators" which include a variety of factors such as access to various Internet channels, Internet penetration, size of the telecommunications industry, and ICT-related R&D and patents.[2] Clearly, the main focus is on access and technical infrastructure, however, one of the factors measures the share of ICT-related occupations in the total economy for a few select countries and would be relevant as an ICT human resource capacity measure. This indicator was developed by Vickery and van Welsum [2004] and is made up of two measures of ICT skilled employment. The first, a narrow metric, measures ICT specialists only, while the other, a broad metric, measures ICT specialists but also includes basic and advanced ICT users. Specifically, their definitions are as follows:

1. ICT *specialists*, who have the ability to develop, operate and maintain ICT systems. ICTs constitute the main part of their job.

[2] For more details on the OECD indicators, go to http://www.oecd.org/document/23/0,2340,en_2649_201185_33987543_1_1_1_1,00.html

2. *Advanced users*: competent users of advanced, and often sector-specific, software tools. ICTs are not the main job but a tool.
3. *Basic users*: competent users of generic tools (*e.g.* Word, Excel, Outlook, PowerPoint) needed for the information society, e-government and working life. Here too, ICTs are a tool, not the main job. [Vickery and van Welsum, 2004, p. 219].

Notice that these definitions are very much oriented toward linking ICT skills and employment of an individual which was the main point of the OECD report.[3] For their study they used mostly census and existing government data from the EU15, the United States, Japan, Republic of Korea, Australia, and Canada. They show which industry sectors have the highest concentration of ICT skilled workers (narrow and broad definitions) within these countries. They then compare this to the productivity numbers in these industry sectors. Unfortunately, this level of industry econometric data is not available in many developing countries.

One of the most important sources of creating human resource capacity is through the country's primary and secondary education system. A recent report by UNESCO outlines seven Basic Core ICT indicators and two additional Extended Core ICT indictors related to ICT usage in education [UNESCO, 2006]. The basic core indicators measure the percentage of schools with electricity, radio sets, televisions sets, basic telecommunication infrastructure, Internet access, plus the student to computer ratio and the percentage of students who use the Internet at school. The extended core measures the percentage of students enrolled by gender at the tertiary level in an ICT-related field and the percentage of ICT-qualified teachers in primary and secondary schools.

As can be seen from this review, there are a wide range of international indicators for measuring e-readiness. What is needed is standardization of these indicators to

[3] These are the definitions used by Raina [2007] to estimate the ICT workforce demands for the Asia Pacific region mentioned earlier.

compare across different studies, advance research collaboration, and provide useful tools for developing countries. The World Summit on the Information Society [WSIS, 2003] called for metrics standardization resulting in the effort by the International Telecommunication Union (ITU) to create the Digital Opportunity Index (DOI). This index is comprised of 11 core ICT indicators representing affordability and access to ICT. However, it does not take into account the ICT human resource capacity of a country.

More recently, the Partnership on Measuring ICT for Development has been working since June 2004 to facilitate a coordinated effort to develop a comprehensive set of ICT indicators.[4] The main objectives of the partnership are to (1) develop an internationally accepted common set of core ICT indicators, (2) to promote the collection of data for this core set of indicators through national statistical offices (NSOs), and (3) develop and make available online a global database on ICT indictors. The first objective was largely accomplished in 2005 when the members of the partnership adopted a core list of ICT indicators at the WSIS Thematic Meeting on Measuring the Information Society in Geneva, February 2005 (UNICT Task Force, 2005a). These indicators are grouped into four sets, including ICT infrastructure and access, access to and use by households and individuals, use by businesses, and the ICT sector (see Appendix A for a list of these adopted core and extended core indicators). While few of these indicators directly measure ICT human resource capacity, several may be useful in inferring skill levels since they measure usage activities by individuals and businesses.[5] In addition,

[4] Membership in the Partnership on Measuring ICT for Development is broad and includes the ITU, the OECD, UNCTAD, UNESCO Institute for Statistics (UIS), four UN Regional Commissions (ECA, ECLAC, ESCAP, and ESCWA), the UN ICT Task Force, the World Bank, and several National Statistics Offices (NSOs). For more information go to http://measuring-ict.unctad.org. Additional information is also available at http://www.itu.int/ITU-D/ict/partnership/index.html.

[5] The single exception may be ICT1 which measures the "Proportion of total business sector workforce involved in the ICT sector".

since this effort represents an internationally agreed upon set of core ICT indicators, we believe this may be useful in developing a set of ICT human resource capacity indicators.

As a starting point for the Partnership's second objective, a major stocktaking exercise of currently available ICT measures was conducted and made available to the public online [UNICT Task Force, 2005b]. In this study, 18 of the 44 Asia Pacific countries responded to the survey administered through ESCAP.[6] Of these eighteen, more than half indicated a very high or high demand for ICT statistics data. Therefore, there is some interest in the region that notes the importance of developing an ICT indicators database. Most of the countries that responded to the survey noted that their National Statistics Offices (NSOs) were responsible for financing the collection of ICT indicator data. None identified international cooperation in financing ICT indicator data.

In terms of what has actually been collected in recent years, 15 of the 18 responding countries have collected data on household and/or business ICT variables in the past decade. Household data collected on *basic access to ICT* are available in countries that account for 60% to 90% of the population in those countries. However, data related to *Internet access* are available in countries that account for only 20% of the population. ICT business indicators including *basic access to ICT* and *Internet access* were available in 35% to 60% of the countries that responded. More specific business ICT indicators were much less represented. It should be noted that the study emphasizes that since China did not respond to the survey, the data for the region is skewed. The status of ICT indicators in China requires further study. Given that only 18 countries in the region responded to the ESCAP survey and that only the most basic ICT indicators

[6] The eighteen countries that responded were Cambodia, Hong Kong SAR, India, Indonesia, Iran, Macao SAR, Malaysia, Maldives, Micronesia, Mongolia, New Caledonia, Niue, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Vanuatu.

have had data collected on them, it is clear that while there is an interest in having ICT indicator data there is a need for much more work on ICT indicators in the region.

3. MULTI-FACTOR ICT HUMAN RESOURCE CAPACITY INDICATORS

As can be seen from the review in the last section there are many indexes that attempt to measure e-readiness of a country, and there are many programs that attempt to develop ICT human resource capacity. However, there are no specific indicators to measure ICT human resource capacity for a country or region. What is needed is a set of indicator categories that address the various types of skills and workforce needed to develop the information society within a country and region. Furthermore, rigorously designed questions to measure the current state of each category should be standardized and internationally agreed upon where possible. Finally, because it will take several years and considerable financing for some countries to be able to collect reliable data on the scale needed to be statistically viable, it would be somewhat helpful to have a less rigorous, easily administered set of questions to use as temporary benchmarks to compare ICT development status with other countries.

3.1 Eight Types of Human Resource Capacity

In this section, we propose eight sets of ICT human resource capacity indicators. These eight sets represent the different types of human resource capacity needed for a flourishing information society and can be broken down into three groupings. The first three sets of indicators represent the extent of the population's participation in the information society. The next two sets of human resource capacity represent the extent to

which the information society impacts the broader society through professional leadership. The final three sets represent the extent of public policy support for creating the information society. See Table 1 for definitions of the eight sets of ICT human resource capacity.

Table 1. Eight Sets of ICT Human Resource Capacity

PRO – ICT Specialists (programmers, vendor certified technicians, etc.)

ICT professionals who have the ability to develop, operate and maintain ICT systems, such that ICTs constitute the main part of their jobs.

ADV – Advanced ICT Users (sector-specific tools, CAD/CAM, online tools, etc.)

Professionals who are competent users of advanced, and often sector-specific, software tools, and where ICTs are not their main job but a tool.

BAS – Basic ICT Users (word processing, spreadsheets, browser, e-mail, etc.)

People who are competent users of generic tools needed for the information society, e-government and working life, but where ICTs are not their main job but a tool.

MGT – ICT Enabling Managers (project managers, strategists, etc.)

Managers who are skilled at putting ICTs to work to meet organizational goals. They may be basic or advanced users, however their main role in ICT adoption is to develop strategies of how to use ICTs, implement systems into their organizations, and plan day-to-day ICT operational excellence.

THT – ICT Thought Leaders (researchers, consultants, professors, etc.)

Those that are most responsible for envisioning the future of the Information Society, understanding its impacts on society, and developing views on how ICT may be used innovatively in the future.

EDU – ICT Equipped Educators (elementary, secondary, etc.)

Elementary and secondary school teachers who are able to integrate ICTs into their teaching activities as both content and tools. They are at the forefront of introducing the next generation of citizens to the Information Society.

POL – ICT Policy Makers (government program developers, budget authorizers, etc.)

Government leaders and other influential policy-makers who are most responsible for developing and funding programmes that promote the adoption and usage of ICTs throughout society.

INF – ICT Infrastructure Builders (standard makers, regulators, e-enablers, etc.)

Government workers and, to some extent, private sector employees who implement policies, develop standards, regulate industries, and develop the public applications that create the Information Society. These applications include e-government, e-health initiatives, e-business infrastructures, etc.

First, we need to make a distinction between e-literacy (basic skills in computers and computer applications) and professional training in information and communication technology (an applied set of skills aimed at supplying the ICT sector with technology professionals). Drawing upon the work of Vickery and van Welsum [2004], we propose our first three indicators.

ICT Specialists are those individuals who have the ability to develop, operate and maintain ICT systems, such that ICTs constitute the main part of their jobs [Vickery and van Welsum, 2004, p. 219]. A good example of someone who is an ICT Specialist is someone who …

… is up-to-date on the latest ICTs,
… has several years of experience in an ICT-related industry sector,
… holds a tertiary degree or degrees in ICT-related field,
… has completed vendor certification training for specific technologies, and/or
… works with ICTs as the main part of their job.

These individuals form the backbone for a productive ICT sector and represent the human resource infrastructure for developing a strong information-intensive society.

Advanced ICT Users are those who are competent users of advanced, and often sector-specific, software tools, and where ICTs are not their main job but a tool. [Vickery and van Welsum, 2004, p. 219]. These include engineers proficient in current computer-aided design and manufacturing software tools, financial analysts that make use of sophisticated analytical programs, and health care professionals that employ current ICT-based information technologies. A good example of someone who is an Advanced ICT User is someone who …

… is considered an information worker, but where ICT is not the main part of their job,
… makes use of advanced ICT tools on the job, but where ICT is not the main part of their job,

… possesses ICT usage skills that generate a competitive advantage for employment,
… can make use of advanced features of certain basic office suite applications, and/or
… can apply industry-specific ICT tools to their job.

These individuals have integrated advanced ICT applications into their professional work life and represent the main ICT-enhanced human resource in today's information-based economy.

Basic ICT Users are those who are competent users of generic tools (e.g. word processing, spreadsheets, browser, e-mail, etc.) needed for the information society, e-government and working life, but where ICTs are not their main job but a tool [Vickery and van Welsum, 2004, p. 219]. The individuals know how to use basic computer applications that are common in today's information society. A good example of someone who is a Basic ICT User is someone who …

… integrates basic ICT tools into everyday life,
… is comfortable with certain office suite type applications,
… goes online regularly,
… uses ICT tools as an important form of communication, and/or
… is able to use online search tools to find information they need.

The individuals may not make use of ICT in their professional lives, but they have the basic skills that allow them to participate in the information society.

The first three sets of ICT human resource capacity represent the extent of the population's participation in the information society. The next two represent the extent to which the information society impacts society through business leadership and thought leadership.

ICT Enabling Managers are those who are skilled at putting ICTs to work to meet organizational goals [Applegate, et al., 2006, p. 3]. They may be basic or advanced users, however their main role in ICT adoption is to develop strategies of how to use ICTs,

implement systems into their organizations, and plan day-to-day ICT operational excellence. These individuals may be skilled at aligning ICT strategy with the business strategy or may possess project management skills necessary to put ICT strategy into practice. A good example of someone who is an ICT Enabling Manager is someone who

… understands the strategic importance of ICT to their organization,
… identifies how ICT can be used innovatively to solve problems,
… understands impediments to putting ICT to work in their organization,
… regularly watches trends about new ICTs, and/or
… understands the security threats ICT usage can bring to their organization.

These individuals form the managerial leadership for putting ICT into practice that helps drive the economic impact of the information economy.

ICT Thought Leaders are those that are most responsible for envisioning the future of the Information Society, understanding its impacts on society, and developing views on how ICT may be used innovatively in the future. These individuals may be university faculty teaching and/or researching the impact of ICT on society, consultants that help drive businesses to use ICT, or visionaries and authors who pave the way toward future developments and develop new ICT-related intellectual property and knowledge [Wagner, et al., 2001]. Very often these individuals act as important change agents to promote technology adoption to the population [Rogers, 1995]. A good example of someone who is an ICT Thought Leader is someone who…

… researches or develops in practice new ways ICT can be used or have impact.
… creates intellectual property about ICT such as patents, articles, books, or presentations.
… advises others about ICT developments.
… interacts with other ICT thought leaders in other organizations.
… understands emerging trends related to the information society.

These individuals are most likely Advanced ICT Users or perhaps ICT Specialists who represent the intellectual capital of the information society. In particular, they act as

change agents and are important for bridging the gap between different organizations and promote proliferation of the technology across organizational and international boundaries.

The last three sets of ICT human resource capacity represent the extent of public policy support for creating the information society.

ICT Equipped Educators are elementary and secondary school teachers who are able to integrate ICTs into their teaching activities as both content and tools. They are at the forefront of introducing the next generation of citizens to the Information Society [ICT in Education, 2006]. A good example of someone who is an ICT-equipped Educator is someone who …

… makes use of ICT tools in their everyday teaching activities,
… integrates the introduction of ICT to students in their lesson plans,
… can help students learn basic ICT skills,
… regularly interacts with other educators using ICT tools, and/or
… uses ICT tools to investigate online sources for new teaching materials and methods.

These individuals are largely responsible for promoting skills and usage in the young generation who are most accepting of new technologies and innovation.

ICT Policy Makers are government leaders and other influential policy-makers who are most responsible for developing and funding programmes that promote the adoption and usage of ICTs throughout society. While not necessarily the thought leaders that create the information society; financial support and programme leadership from these individuals is critical to developing the information society. A good example of someone who is an ICT Policy Maker is someone who …

… understands how ICT can contribute to economic development and poverty reduction.

… understands how ICT can be used in the public and private sectors to improve education and create an informed citizenry.
… cooperates with a multitude of people in public and private organizations to develop programmes that promote ICT adoption and usage.
… is adept at using their position of authority to help fund and implement new programmes that promote ICT adoption and usage.
… understands the country's ICT strategy and policies.

Policy makers need to understand the importance of ICT to developing economies and how to best develop and fund programmes that create a conducive ICT sector climate. Indeed, without these policy makers it is doubtful that ICT will be widely adopted throughout society.

ICT Infrastructure Builders are government workers and, to some extent, private sector employees who implement policies, develop standards, regulate industries, and develop the public applications that create the Information Society. These applications include e-government, e-health initiatives, e-business infrastructures, etc. These individuals serve on standards development bodies, work in government organizations that build e-government applications, and enforce ICT regulatory policies that can open the door to a thriving ICT section and the information society or swamp the system in bureaucratic red tape. A good example of someone who is an ICT Infrastructure Builder is someone who …

… works with organizations to create the standards, regulations, and protocols on which the Information Society is built,
… is involved in the development of e-based initiatives such as e-government or e-health programmes to bring Web-enabled services to the people,
… understands governmental policies and regulations that promote and inhibit ICT adoption by the population,
… works with private ICT sector service providers to promote ICT usage within the population, and/or
… understands the basic infrastructures, including ICT policies, architectures, and programmes, upon which an information society is built.

These individuals are the main architects of the public-initiated information society that typically includes e-government applications and e-health programmes.

3.2 Proposed ICT Human Resource Capacity Indicators

To the extent possible, we desire to use accepted metrics to measure the ICT human resource capacity indictors. The core set of ICT indicators shown in Appendix A as developed by the Partnership on Measuring ICT for Development (PMID) forms a starting point for measurement [UNICT Task Force, 2005a]. Further, the RAND study contains several useful indicators that can be modified to the ICT context to supplement the PMID indicators [Wagner, et al., 2001]. The proposed eight sets of ICT human resource capacity indicators are summarized in Table 2.

For the three sets of indicators that measure the population's participation in the information society we use mostly PMID agreed to measures. ICT Specialists (**PRO**) is a combination of one PMID and an adapted RAND indicator that measures the relative size of the country's ICT industry sector. The Advanced ICT Users (**ADV**) is an indirect measure based on two PMID indicators of ICT use in the workplace. The Basic ICT Users (**BAS**) is a composite of three PMID indicators of household use of ICT.

Table 2. Measurement of ICT Human Resource Capacity Indicators	
Indicator Category	Indicator Measurement
PRO ICT Specialists	**ICT1** Proportion of total business sector workforce involved in the ICT sector (proposed by PMID) **PRO1** The number of ICT professionals per million people (new; to be adapted from RAND)
ADV Advanced ICT Users	**B2** Proportion of employees using computers (proposed by PMID) **B4** Proportion of employees using the Internet (proposed by PMID)
BAS Basic ICT Users	**HH6** Proportion of individuals who used a computer (from any location) in the last 12 months (proposed by PMID) **HH8** Proportion of individuals who used the Internet in the last 12 months (proposed by PMID) **HH10** Internet activities undertaken by individuals in the last 12 months (proposed by PMID) • Getting information: (a) about goods or services; (b) related to health or health services; (c) from government organizations/public authorities via websites or email; and (d) other information or general Web browsing • Communicating • Purchasing or ordering goods or services • Internet banking • Education or learning activities • Dealing with government organizations/public authorities • Leisure activities: (a) playing/downloading video or computer games; (b) downloading movies, music or software; (c) reading/downloading electronic books, newspapers or magazines; and (d) other leisure activities
MGT ICT Enabling Managers	**B1** Proportion of businesses using computers (proposed by PMID) **B3** Proportion of businesses using the Internet (proposed by PMID) **B5** Proportion of businesses with a Web presence (proposed by PMID) **B6** Proportion of businesses with an intranet (proposed by PMID) **B7** Proportion of businesses receiving orders over the Internet (proposed by PMID) **B8** Proportion of businesses placing orders over the Internet (proposed by PMID) **B11** Proportion of businesses with an extranet (proposed as Extended Core by PMID) **B12** Proportion of businesses using the Internet by type of activities (proposed as Extended Core by PMID) • Sending and receiving email • Getting information: (a) about goods and services; (b) from government organizations/public authorities via websites or email; and (c) other information searches or research activities • Performing Internet banking or accessing other financial services • Dealing with government organizations/public authorities • Providing customer services • Delivering products online

Table 2. Measurement of ICT Human Resource Capacity Indicators (cont)	
Indicator Category	Indicator Measurement
THT ICT Thought Leaders	**THT1** The number of ICT management professionals per million people to capture the ICT thought leadership within the private sector (new; to be adapted from RAND) **THT2** The number of ICT journal articles and patents produced by citizens of the nation to characterize ICT knowledge asset outputs (new; to be adapted from RAND) **THT3** The number of universities and research institutions that have ICT-related programs in the nation per million people to characterize the infrastructure for generating ICT knowledge assets (new; to be adapted from RAND) **THT4** The number of ICT-related patents filed through the U.S. Patent and Trademark Office (USPTO), the European Patent Office (EPO), or another regional patent office (new; to be adapted from RAND)
EDU ICT Equipped Educators	**ED1** % of schools with electricity (proposed by UNESCO) **ED2** % of schools with a radio set used for educational purposes (proposed by UNESCO) **ED3** % of schools with television set used for educational purposes (proposed by UNESCO) **ED4** Student to computer ratio (proposed by UNESCO) **ED5** % of schools with basic telecommunication infrastructure or telephone access (proposed by UNESCO) **ED6** % of schools with an Internet connection (proposed by UNESCO) **ED7** % of students who use the Internet at school (proposed by UNESCO) **ED9** % of ICT-qualified teachers in primary and secondary schools (of the total number of teachers) (proposed by UNESCO)
POL ICT Policy Makers	**A1** Fixed telephone lines per 100 inhabitants (proposed by PMID) **A2** Mobile cellular subscribers per 100 inhabitants (proposed by PMID) **A6** International Internet bandwidth per inhabitant (proposed by PMID) **A7** Percentage of population covered by mobile cellular telephony (proposed by PMID) **A8** Internet access tariffs (20 hours per month), in US$, and as a percentage of per capita income (proposed by PMID) **A9** Mobile cellular tariffs (100 minutes of use per month), in US$, and as a percentage of per capita income (proposed by PMID) **A10** Percentage of localities with public Internet access centres (PIACs) by number of inhabitants (rural/urban) (proposed by PMID) **ICT2** Value added in the ICT sector (as a percentage of total business sector value added) (proposed by PMID)
INF ICT Infrastructure Builders	**HH10** Internet activities undertaken by individuals in the last 12 months (proposed by PMID) • Getting information: (a) about goods or services; (b) related to health or health services; (c) from government organizations/public authorities via websites or email; and (d) other information or general Web browsing • Education or learning activities • Dealing with government organizations/public authorities

The first of the two sets of indicators that represent the extent to which the information society impacts society through professional leadership, ICT Enabling Managers (**MGT**), is a composite of six core PMID indicators that measure business usage of ICT, plus two PMID indicators that are considered Extended Core. As such, PMID recognizes that inclusion of this data may be overly burdensome; however, their inclusion here would be beneficial to measure more innovative business use of ICT. To measure ICT Thought Leaders (**THT**) we propose four indicators that are adaptations of the RAND measures that represent the extent to which ICT intellectual capital is created within the society.

The first of the three sets of indicators representing public policy support is for ICT Equipped Educators (**EDU**). Here we note that UNESCO's ICT in Education initiative has been working to promote ICT adoption by educators in developing countries [ICT in Education, 2006].[7] They have recently released a series of ICTs in Education Indicators which we have incorporated into our list [UNESCO, 2006]. To indirectly measure the extent to which ICT Policy Makers (**POL**) human resource capacity exists, we propose the use of eight core PMID indicators that represent the extent to which the country's ICT infrastructure has been developed. Finally, to indirectly measure ICT Infrastructure Builders (**INF**), we propose the use of the PMID core indicator that measures household use e-based applications developed by these people, such as e-government, e-health, etc.

The vase majority of our proposed ICT human resource capacity indicators have already been adopted by the Partnership on Measuring ICT for Development. However,

[7] The ICT in Education initiative by UNESCO provides various metrics on how ICT is being used in education. For a list of indicators, see http://www.unescobkk.org/index.php?id=825

it was necessary to propose a few additional indicators beyond their efforts. We propose a close association be developed to work with the PMID to encourage them to modify their indicators to include the additional ones proposed here, as well as to adopt the ICT indicators in education as proposed by UNESCO. Also, we propose this partnership include efforts to work with them to encourage National Statistical Offices (NSOs) in their data collection efforts.

Finally, while we believe the accumulation of this database of objective ICT human resource capacity data is an important objective, we also recognize that it may take some countries several years to adequately begin objective data collection efforts on this scale. For this reason, we have proposed a set of subjective indicators in Appendix B that can be used for preliminary benchmarking purposes. Similar subjective indicators have proven useful for policy makers in the absence of other objective data. While the indicators in Appendix B should not be used as a substitute for developing the quantitative measures, we believe they can be useful in the short-term. In particular, this type of subjective data collection can be done quickly and is useful for raising awareness of the issues that need to be considered. Further, this type of survey will cause policy makers to think carefully about the different types of human resource capacity that may be useful in promoting the Information Society.

4. DATA COLLECTION ISSUES

Developing a useful database of ICT indicator data is a long-term proposition that requires cooperation by a variety of international and national organizations. The stocktaking exercise conducted by the Partnership on Measuring ICT for Development

found that many Asia Pacific countries did not participate in the exercise. In some cases, high population countries like China did not participate raising concerns about the feasibility of developing a useful dataset when large portion of the global population are not included in the data. In other cases, certain regions were woefully underrepresented in the response set, most notably Central Asia and the Pacific Island nations. The United Nations and UN-based organizations such as the APCICT are ideally suited to encourage the widespread cooperation needed to develop a useful database of ICT indicator data.

In most cases, the collection of ICT indicator data should be coordinated by the country's National Statistics Office (NSO) or the government ministry most responsible for ICT. Making the NSO the coordinating body for the data collection effort has several important ramifications (UNICT Task Force, 2005b). First, it boosts credibility of the effort within the country thereby increasing the level of cooperation from important stakeholders. Second, NSOs typically have the statistical and cultural expertise necessary for an effective contextualized data collection effort. This tends to increase the quality of the data collected. Finally, with the backing of the country's NSO, the results of the data collection effort are more likely to be used in governmental policy formulation. While international organizations and private firms have conducted ICT indicator data collection efforts, they typically are not applied at the policy-making level.

While some countries have well developed National Statistics Offices, other countries lag behind in developing a sustainable, qualified NSO. A study published by the United Nations Economic and Social Council [UNESC, 2003] examined whether National Statistics Offices that were surveyed between May and November 2003 followed a recommended set of Fundamental Principles of Official Statistics. Of the 48

countries in Asia that received the survey 36 responded indicating a response rate of 75%. However, of the 15 countries in Oceania that received the survey, only 5 (33%) responded.[8]

Stability of funding of the data collection effort is critical if it is to be sustainable. While many of the NSOs allocate funding for ICT indicator data collection, most countries do not have multi-year financing plans for this type of activity jeopardizing the potential long-term usefulness of ICT indicator data. Due to the dynamic nature of the ICT environment it is important to develop a long-term consistent set of ICT indicator data. While ownership of the data collection effort should be with the NSOs, the funding necessary to develop a multi-nation database of indicator data should at least in part be done by an international organization such as the United Nations.

Further, while NSOs should take the lead in coordinating the data collection efforts, they should work in cooperation with, and be advised by, international organizations such as APCICT, other UN-affiliated organizations, and reputable organizations with data collection expertise. This will serve to enhance the credibility of the effort to outside organizations, lead to a standardized set of ICT indicator data, and improve the usefulness of the data for global studies on ICT policy. The questions used in the data collection effort should be based on agreed upon International standards. The Partnership on Measuring ICT for Development has developed suggested questions for each of it's agreed upon indicators.

While the data collection effort should be coordinated by the country's NSO, it may be beneficial to work through a local organization that will actually administer the questionnaire, such as the civil service or a researcher in the country. In terms of the

[8] The total response rate of the 194 countries surveyed was 58% based on 100 responding countries.

specific data collection effort, there are several other country-specific contextual factors that should be taken into consideration. While questions should be based upon internationally agreed upon standards, the questions should be translated into the local language and should be made as simple as possible. In term of collecting data at the local level, it typically would be beneficial to have the support from community leaders including local religious leaders which will increase cooperation of respondents. Similarly, it should be noted that different countries have different holidays that need to be taken into account when data is collected. There are various types of media to use in this type of survey. A paper-based survey is the best, although an online survey is economical, yet not representative. Finally, data should be made available publicly as soon as possible after the data has been determined to be reliable. Organizations that participate in the data collection at the national and local level should be assured that they will receive access to the data relatively quickly in order to increase incentives to participate and cooperate.

5. CONCLUSION

In applying the eight sets of indicators, it is important to note that Barzilai-Nahon [2006] points out that the context of the nation's situation should be considered when developing indicators to measure the digital divide. In particular, she asks whether the indicator is trying to measure a specific factor, such as connectivity, or the general divide. In particular, if we are attempting to measure monotopical factors then context is less important and the indicator can be used for comparative purposes. However, if we are trying to measure the more complicated digital divide, then context must be included. In

such a case, countries that do not have infrastructure will need to put more weight on infrastructure factors, while countries with built out infrastructure will put less weight on infrastructure in favor of other factors.

In developing a set of indicators for ICT human resource capacity countries will need to consider their context in determining which sectors and skill types should be granted more weighting. For example, if the most basic ICT skills are not widespread in the population, then the country may need to put more emphasis on basic skills and use in primary and secondary education contexts. For countries that do not have a well-developed ICT infrastructure, it might be more appropriate to emphasize the need for policy makers and other government officials that have an awareness of the potential for using ICT and how it can impact broader development objectives. For more advanced countries, it may be more appropriate to emphasize the development of ICT thought leaders at the university or consulting level.

This proposed set of ICT human resource capacity indicators can be used by countries to benchmark their progress in developing a multi-factor skill set within their population to further the development of the information society. In addition, policy makers can use this multi-factor set of indicators to develop programmes that meet the specific contextual needs of the country. Tertiary educational institutions can use this multi-factor set of indicators to develop degree and non-degree programs based on the contextual need of the host country. Also, international aid organizations and other NGOs can use these indicators to target funding and develop training programmes that are more customized to meet the needs of the target country under consideration. Finally, by applying a multi-factor approach, training organizations can better divide the

responsibility of developing these programmes by focusing on specific types of skills sets as defined here by the eight types of ICT human resource capacity needed by developing countries.

Organizations like the United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development are well placed in Asia to facilitate the global data collection effort needed to establish an online database of ICT human resource capacity indicators. Long-term funding of such an effort resulting in collaboration with the Partnership on Measuring ICT for Development will help determine more precise ICT needs in the Asia Pacific region and will help policy makers and international development organizations bridge the digital divide in the region and create productive members of the Information Society. Specific recommendations for the APCICT are included in Appendix C.

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Appendix A
Partnership on Measuring ICT for Development
Set of Core ICT Indicators
[UNICT Task Force, 2005a]

Core indicators on ICT infrastructure and access

Basic core

A1 Fixed telephone lines per 100 inhabitants
A2 Mobile cellular subscribers per 100 inhabitants
A3 Computers per 100 inhabitants
A4 Internet subscribers per 100 inhabitants
A5 Broadband Internet subscribers per 100 inhabitants
A6 International Internet bandwidth per inhabitant
A7 Percentage of population covered by mobile cellular telephony
A8 Internet access tariffs (20 hours per month), in US$, and as a percentage of per capita income
A9 Mobile cellular tariffs (100 minutes of use per month), in US$, and as a percentage of per capita income
A10 Percentage of localities with public Internet access centres (PIACs) by number of inhabitants (rural/urban)

Extended Core

A11 Radio sets per 100 inhabitants
A12 Television sets per 100 inhabitants

Core indicators on access to, and use of, ICT by households and individuals

Basic Core

HH1 Proportion of households with a radio
HH2 Proportion of households with a TV
HH3 Proportion of households with a fixed line telephone
HH4 Proportion of households with a mobile cellular telephone
HH5 Proportion of households with a computer
HH6 Proportion of individuals who used a computer (from any location) in the last 12 months
HH7 Proportion of households with Internet access at home
HH8 Proportion of individuals who used the Internet in the last 12 months
HH9 Location of individual use of the Internet in the last 12 months: (a) at home; (b) at work; (c) place of education; (d) at another person's home; (e) community Internet access facility (specific denomination depends on national practices), (f) commercial Internet access facility (specific denomination depends on national practices), and (g) others
HH10 Internet activities undertaken by individuals in the last 12 months

- Getting information: (a) about goods or services; (b) related to health or health services; (c) from government organizations/public authorities via websites or email; and (d) other information or general Web browsing
- Communicating
- Purchasing or ordering goods or services
- Internet banking
- Education or learning activities
- Dealing with government organizations/public authorities
- Leisure activities: (a) playing/downloading video or computer games; (b) downloading movies, music or software; (c) reading/downloading electronic books, newspapers or magazines; and (d) other leisure activities

Extended core

HH11 Proportion of individuals with use of a mobile telephone

HH12 Proportion of households with access to the Internet by type of access: Categories should allow an aggregation to narrowband and broadband, where broadband excludes slower speed technologies, such as dial-up modem, ISDN and most 2G mobile phone access. Broadband will usually have an advertised download speed of at least 256 kbit/s.

HH13 Frequency of individual access to the Internet in the last 12 months (from any location): (a) at least once a day; (b) at least once a week but not every day; (c) at least once a month but not every week; and (d) less than once a month.

Reference indicator

HHR1 Proportion of households with electricity

Core indicators on use of ICT by businesses

Basic core

B1 Proportion of businesses using computers

B2 Proportion of employees using computers

B3 Proportion of businesses using the Internet

B4 Proportion of employees using the Internet

B5 Proportion of businesses with a Web presence

B6 Proportion of businesses with an intranet

B7 Proportion of businesses receiving orders over the Internet

B8 Proportion of businesses placing orders over the Internet

Extended core

B9 Proportion of businesses using the Internet by type of access: Categories should allow an aggregation to narrowband and broadband, where broadband excludes slower speed technologies, such as dial-up model, ISDN and most 2G mobile phone access. Broadband will usually have an advertised download speed of at least 256 kbit/s.

B10 Proportion of businesses with a Local Area Network (LAN)

B11 Proportion of businesses with an extranet

B12 Proportion of businesses using the Internet by type of activities

- Sending and receiving email
- Getting information: (a) about goods and services; (b) from government organizations/public authorities via websites or email; and (c) other information searches or research activities
- Performing Internet banking or accessing other financial services
- Dealing with government organizations/public authorities
- Providing customer services
- Delivering products online

Core indicators on the ICT sector and trade in ICT goods

ICT1 Proportion of total business sector workforce involved in the ICT sector

ICT2 Value added in the ICT sector (as a percentage of total business sector value added)

ICT3 ICT goods imports as a percentage of total imports

ICT4 ICT goods exports as a percentage of total exports

Appendix B
Subjective Measures for the ICT Human Resource Capacity Indicators

PRO – ICT Specialists

1. In our country, we have a supply of ICT specialists who are up-to-date with the latest information and communication technologies.
   None Few Some Adequate Abundant

2. In our country, we have a supply of ICT specialists who have several years of work experience in an ICT-related industry sector.
   None Few Some Adequate Abundant

3. In our country, we have a supply of ICT specialists who hold tertiary degrees in an ICT-related field.
   None Few Some Adequate Abundant

4. In our country, we have a supply of ICT specialists who have completed vendor certification training for specific technologies.
   None Few Some Adequate Abundant

5. In our country, we have a supply of ICT specialists who work with ICTs as the main part of their jobs.
   None Few Some Adequate Abundant

ADV – Advanced ICT Users

1. In our country, we have a supply of advanced ICT users who would be considered information workers, but where ICT is not the main part of their jobs.
   None Few Some Adequate Abundant

2. In our country, we have a supply of advanced ICT users who make use of advanced ICT tools on their job, but where ICT is not the main part of their jobs.
   None Few Some Adequate Abundant

3. In our country, we have a supply of advanced ICT users who possess ICT usage skills that generates a competitive advantage for them in their employment.
   None Few Some Adequate Abundant

4. In our country, we have a supply of advanced ICT users who can make use of advanced features of certain office suite applications.
   None Few Some Adequate Abundant

5. In our country, we have a supply of advanced ICT users who can apply industry-specific ICT tools to their jobs.
   None Few Some Adequate Abundant

BAS – Basic ICT Users

1. In our country, our citizens have integrated basic ICT tools into their everyday life.
   None Few Some Adequate Abundant

2. In our country, our citizens are comfortable with certain office suite applications.
   None Few Some Adequate Abundant

3. In our country, our citizens go online regularly.
   None Few Some Adequate Abundant

4. In our country, our citizens use ICT tools as an important form of communication.
   None Few Some Adequate Abundant

5. In our country, our citizens are able to use online search tools to find information they need.
   None Few Some Adequate Abundant

MGT – ICT Enabling Managers

1. In our country, we have a supply of managers who understand the strategic importance of ICT to their organizations.
   None Few Some Adequate Abundant

2. In our country, we have a supply of managers who can identify how ICT can be used innovatively to solve problems.
   None Few Some Adequate Abundant

3. In our country, we have a supply of managers who understand the impediments to putting new ICT to work in their organizations.
   None Few Some Adequate Abundant

4. In our country, we have a supply of managers who regularly watch trends about new ICTs.
   None Few Some Adequate Abundant

5. In our country, we have a supply of managers who understand the security threats ICT usage can bring to their organizations.
   None Few Some Adequate Abundant

THT - ICT Thought Leaders

1. In our country, we have ICT experts who research, or develop in practice, new ways ICT can be used or have impact.
   None Few Some Adequate Abundant

2. In our country, we have ICT experts who create intellectual property about ICT such as patents, articles, books, or presentations.
   None Few Some Adequate Abundant

3. In our country, we have ICT experts who advise others about ICT developments.
   None Few Some Adequate Abundant

4. In our country, we have ICT experts who interact with other ICT thought leaders in other organizations.
   None Few Some Adequate Abundant

5. In our country, we have ICT experts who make it their business to understand emerging trends related to the information society.
   None Few Some Adequate Abundant

EDU – ICT Equipped Educators

1. In our country, our elementary and secondary school teachers make use of ICT tools in their everyday teaching activities.
   None Few Some Adequate Abundant

2. In our country, our elementary and secondary school teachers integrate introduction of ICT to students in their lesson plans.
   None Few Some Adequate Abundant

3. In our country, our elementary and secondary school teachers can help students learn basic ICT skills.
   None Few Some Adequate Abundant

4. In our country, our elementary and secondary school teachers regularly interact with other educators using ICT tools.
   None Few Some Adequate Abundant

5. In our country, our elementary and secondary school teachers use ICT tools to investigate online sources for new teaching materials and methods.
   None Few Some Adequate Abundant

POL – ICT Policy Makers

1. In our country, we have government leaders and other influential policy-makers who understand how ICT can contribute to economic development and poverty reduction.
   None Few Some Adequate Abundant

2. In our country, we have government leaders and other influential policy-makers who understand how ICT can be used in the public and private sectors to improve education and create an informed citizenry.
   None Few Some Adequate Abundant

3. In our country, we have government leaders and other influential policy-makers who cooperate with a multitude of people in public and private organizations to develop programmes that promote ICT adoption and usage.
   None Few Some Adequate Abundant

4. In our country, we have government leaders and other influential policy-makers who are adept at using their positions of authority to help fund and implement new programmes that promote ICT adoption and usage.
   None Few Some Adequate Abundant

5. In our country, we have government leaders and other influential policy-makers who understand the country's ICT strategy and policies.
   None Few Some Adequate Abundant

INF – ICT Infrastructure Builders

1. In our country, we have government workers and, to some extent, private sector employees who work with organizations to create the standards, regulations, and protocols on which the Information Society is built.
   None Few Some Adequate Abundant

2. In our country, we have government workers and, to some extent, private sector employees who are involved in the development of e-based initiatives such as e-government or e-health programmes to bring Web-enabled services to the people.
   None Few Some Adequate Abundant

3. In our country, we have government workers and, to some extent, private sector employees who understand governmental policies and regulations that promote and inhibit ICT adoption by the population.
   None Few Some Adequate Abundant

4. In our country, we have government workers and, to some extent, private sector employees who work with private ICT sector service providers to promote ICT usage within the population.

   None Few Some Adequate Abundant

5. In our country, we have government workers and, to some extent, private sector employees who understand the basic infrastructures, including ICT policies, architectures, and programmes, upon which an information society is built.

   None Few Some Adequate Abundant

Appendix C
Recommendations for APCICT on ICT Indicators

Due to budgetary constraints and human resource limitations it may not be feasible for APCICT to be extensively involved in the area of ICT indicator development and data collection. Indeed, in their 2007 meeting and recommendations the APCICT Governing Council recommended that at this point in time APCICT should not be focusing on the ICT indicator area. This is a major effort that will require collaboration across the international community and a long-term commitment to ICT indicator development and data collection. We offer three alternatives that APCICT should consider for their involvement in ICT indicators with a specific recommendation to follow.

Alternative 1

APCICT should be closely integrated with the work of the international community that is involved in collecting ICT indicator data. APCICT will not actually collect data as that will be done at the country level. However, APCICT should work closely with international organizations to promote the efforts of National Statistics Offices (NSOs) to collect this data within their country. An APCICT representative should be assigned to get involved with the work of the Partnership on Measuring ICT for Development. This can be done through the ESCAP office as that is the Partnership's interface with the Asia Pacific region. This will include:

- Attend and represent APCICT at regional and perhaps global conferences and workshops put on by the Partnership.
- Take on tasks associated with the Partnership to promote their work and agenda.

- Make presentations at Partnership meetings to update attendees on the efforts of data collection in Asia and the Pacific region.
- Promote the revision of the Partnership's agreed upon ICT indicators to include the few additional indicators not currently agreed upon by the Partnership, but that would be valuable to APCICT.
- Attend and represent APCICT at regional workshops that promote the collection of ICT indicator data by country level National Statistics Offices (NSOs).
- As data is collected, it should be reinterpreted in a meaningful way for APCICT to advise programme-building efforts.

Alternative 2

APCICT should monitor the activities of the international community that is involved in collecting ICT indicator data. APCICT will not actually collect data or be directly involved in the activities of the ICT indicators international community, but rather make use of data as it is collected. An APCICT representative should be assigned to monitor and interface with the work of the Partnership on Measuring ICT for Development. This can be done through the ESCAP office as that is the Partnership's interface with the Asia Pacific region. This will include:

- Attend regional conferences and workshops put on by the Partnership.
- Suggest the revision of the Partnership's agreed upon ICT indicators to include the few additional indicators not currently agreed upon by the Partnership, but that would be valuable to APCICT.
- As data is collected by the Partnership, it should be reinterpreted in a meaningful way for APCICT to advise programme-building efforts.

Alternative 3

APCICT should make use of ICT indicator data as it is collected through the Partnership on Measuring ICT for Development and make use of this data in its programme building efforts.

Recommendation

Due to budgetary constraints and human resource limitations it is recommended that APCICT at this point in time follow Alternative 2 where an APCICT representative is assigned to monitor and interface with the activities of the Partnership on Measuring ICT for Development from a distance. It is hoped that in 2008 APCICT can make a larger commitment to the international community in this area and move to Alternative 1 where an APCICT representative would become actively involved in the tasks of the Partnership.